ELECTRICAL REVIEW

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District Heating

Information Required on Many Aspects

IT is no new thing that engineers should be dissatisfied that even under the best conditions more than half of the heat units in steam produced for generating electricity should pass to the condensing water. One way of avoiding the loss of latent heat entailed is to use the exhaust of the turbine as steam for industrial processes, although the attainment of the high thermal efficiency possible through the combined system cannot by any means be assumed necessarily to give results comparable in economy with those achieved by more normal methods.

Schemes Under Consideration

An extension of the scope of the system to the public distribution of steam or hot water is now being increasingly advocated under the name of "district heating." Steps have been taken in several towns to consider its potentialities, Halifax according to references in the local Press being the most recent, while a scheme proposed for Bristol was described by us on November 5th. Further action will presumably await the results of investigations by a sub-committee of the Department of Scientific and Industrial Research with Coventry as its principal theme.

Attention has generally been focused hitherto on the elementary theoretical heat balance of combined schemes which have become familiar in connection with process-steam claims, whereas most of the difficulties are likely to be encountered outside the generating station. Few details relevant to conditions in this country are available from foreign practice and these are not invariably reassuring, either on financial grounds or in regard to their effect on the production of electricity, thermal efficiencies credited to the latter being in many instances lower than were common here forty years ago.

When such schemes have apparently fulfilled expectations, the number of BThU sold per foot of distributing main has been higher than would be required during most winters in this country. On the other hand the effects of our milder climate would, it is claimed, be offset by the longer duration of our relatively cold season and by the large quantities of hot water needed in the summer. Much is also expected of heat accumulators in smoothing out variations in demand over short periods.

Questions to be Answered

Before it can be determined whether British climatic conditions are such as to make district heating feasible and whether the implied considerable modifications in present generating practice would be worth while, many questions regarding distribution will need definite answers. Prominent among these are: Capital costs incurred on supply mains and consumers' heating installations as compared with other methods; economic areas of supply, about which authorities differ widely; load densities; annual heat loss; size of mains, which may be a major obstacle in congested sub-soils; maintenance costs; effect of hot pipes on other

services necessarily in their neighbourhood. There is also the important aspect of the period within which a scheme would become self-supporting after its inception. On the evidence at present available it would appear that prospects for the successful adoption in Great Britain of district heating are likely to be restricted to new compact small towns or to existing densely loaded areas that have been devastated by enemy action. In any event, no obstacle should be allowed to prevent the supplying of industry as a whole with electrical energy at prices that are based based on the normal trend of generating costs shown in present practice.

Housing Shortage

ELECTRICAL contractors, as well as manufacturers, who were anticipating ample employment for all their workers within a reasonable time after the war may have been disappointed by the Minister of Health's statement that only 300,000 houses out of the four million required, could be provided during the first two years. After the last war it took twenty-one years to build four million houses, which is said to be the present need; it is to be hoped that the measures being taken by the Government will result in a faster pace than this. Of course, apart from the very considerable hardship which will be caused by undue delay, it is not a bad thing to have the work spread over a reasonable time. Much better this than a few years of intense activity followed by a more or less sudden collapse. In his last Sunday's broadcast Mr. Churchill hoped that half a million pre-fabricated houses would be made.

Possible Danger

ONE thing must be guarded against in attempts to speed up the housing programme. Too great a clamour for immediate houses may lead to the relaxation or even abandonment of the ideas for proper construction and equipment which have been so much discussed. Houses at all costs may mean jerry building, with inferior and inadequate electrical installations and equipment. If the Government is compelled by public needs or political pressure to throw open the field to all comers the people may secure houses but with them they will acquire endless inconvenience, trouble and expense.

Engineers' Conditions

FOR what, no doubt, have been good and sufficient reasons the leading British engineering institutions have always considered the protection of the conditions of employment of their members to be outside their scope. This attitude stands in contrast to that of the American Society of Civil Engineers which has just decided to permit its local sections to act as "collective bargaining agents" for engineers. The *Electrical World* says that fifteen of the fifty-four sections are amending their constitutions to "permit employee members to form collective bargaining groups when such members find it desirable or necessary to avoid being compelled to join one of the existing trade unions."

Post-War Prosperity

AT the County of London Company's meeting last week, Sir Robert Renwick emphasised a point to which we have already drawn attention. That is, although the loss of the enormous war load might reasonably be expected to leave us with a surplus of generating capacity, there will, in fact, more probably be a shortage. New power stations will be needed and old ones will have to be extended. While all industries will be clamouring for the plant and equipment necessary to meet the released demand, the responsible authorities will have to bear in mind the dependence of these industries upon an adequate supply of electric power. This, as Sir Robert said, should ensure for the electricity supply industry special consideration. Sir Robert mentioned that the company reached its jubilee this year; it was now serving 400,000 customers in an area of 1,000 sq. miles, or, including subsidiary and associated companies, nearly 3,000 sq. miles.

Shareholders as Rentiers

IT is not always the case, as Sir Joseph Nall suggested at the Lancashire Electric Light & Power Co.'s meeting last week, that the acquisition of an undertaking by a public board means the conversion of the shareholders into rentiers with a certain fixed income, whether earned by the undertaking or not. We have in mind the "C" stock of the London Passenger Transport Board. Upon this the standard rate of dividend

is 5½ per cent. but the holders were quite agreeably surprised to receive 3¼ per cent. in respect of last year. The "non-gilt-edged" character of the stock is indicated by the fact that at one time in 1940 the price went down to 24; it stands at about 70 now.

Supply Companies' Assessments

MAJOR H. RICHARDSON mentioned at the annual meeting of the Metropolitan Electric Supply Co. that the amount paid by the company and its associated concerns in rates to local authorities was 40 per cent. higher in 1943 than in the preceding year. Major Richardson seems to be justified in wondering what benefit the company and its consumers derived from this greatly increased charge and in contending that revision of the present methods of valuation and rating of the industry is long overdue.

Industrial Films

MR. W. L. BARBER, of the Midland Electric Manufacturing Co., and others had something to say about "official" films dealing with factory production at a recent exhibition of such films. Some objections to them were that they did not tell a connected story and lacked the necessary light touches for factory audiences. There was too much undisguised propaganda and too many amateur actors. "Amateur" in this context probably means actors without real knowledge of their material. The Midland Regional Information Officer promised improvements; perhaps the producers might pick up a few tips from E.D.A.

Competition

"BEFORE the war competition between gas and electricity in some areas had reached a pitch of bitterness which was harmful both to the undertakings concerned and to the general public." Thus Mr. Leslie Hardern at a recent meeting of the Town and Country Planning Association. It is significant that this oft-repeated and erroneous contention always comes from gas or gas-inspired interests. The remedy, as always, is "regulation" generally by a body in which gas has the most say. In Mr. Hardern's view the proposed National Fuel Advisory Council is the appropriate organisation. Mr. Hardern admits that "it is not desirable and it would not be tolerated by the community, that fuels for certain purposes be rigidly allocated and their use for other purposes prohibited." Oh no! "The function of the Council should be not to destroy but to regulate competition, to check abuses, to stimulate improvements and to ensure that due regard is paid to the national welfare."

Circular Fluorescents

WHAT is described as "a brand new lighting tool" is announced by the Westinghouse Co. as one of its developments for post-war production. It takes the form of circular fluorescent lamps of 20, 30 and 40 W rating, the diameters of the circles of 1¼ in. tubes being 8·5, 12·25 and 16 in. respectively. These should give quite powerful concentrations of light, but there seems to be something to be said for the distributive characteristic of the straight-line form which has been seen here, so far, only in the 5-ft. length. Their use as portable lamps is suggested; it is in this application that the more compact arrangement should be an advantage.

Loophole Closed

IN January a summons against a London hotel company alleging the excessive use of electric light in a reading room was dismissed. The company pleaded that as well as the room in which they were installed the lamps illuminated, through a glass wall, the entrance, some stairs and a foyer of the hotel. Possibly as the result of this case the Ministry of Fuel and Power has now issued a General Direction which amends a previous Direction so as to exclude from the calculation of the area of an illuminated room any place which may incidentally receive some illumination from the lights in that room. This no doubt necessary piece of departmental legislation shows how easy it is for Ministries to close up gaps in their Orders as and when they are discovered.

Tailpiece

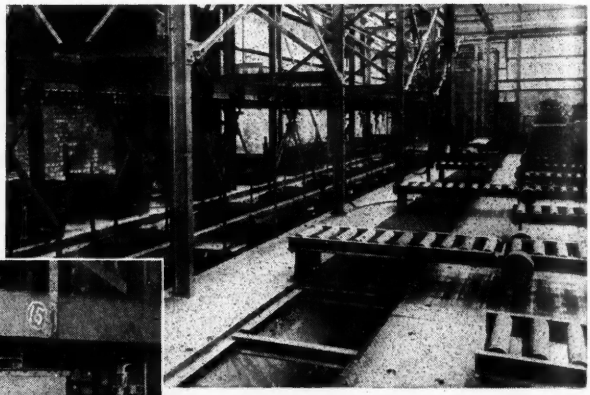
LAUDABLE endeavour to comply with economy appeals is shown by an advertiser in the *Exchange and Mart* who is trying to dispose of a 230-V 600-A bowl fire. Unfortunately he is encouraging extravagance on somebody else's part, for he is only asking 25s. for this 138-kW appliance.

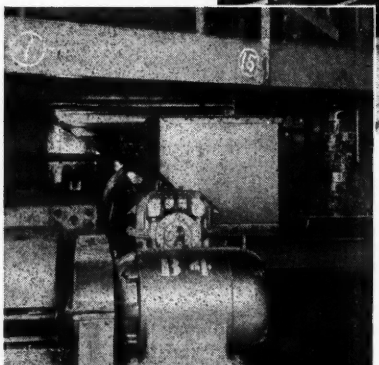
Up-to-Date Foundry

Electrical Applications to Fully Mechanised Plant

THE foundry for the steel-making plant referred to in the *Electrical Review* of March 10th is arranged in an extension of the steel-plant building, while the fettling and finishing sections are housed in a separate building on the other side of an access roadway. Although the lay-out is compact there is no cramping of space in any of the separate sections of the plant, which is laid out for the production of repetition castings or for jobbing work, if and when necessary. Sand for moulding is handled in a closed cycle, the core-making being kept separate in a department of its own.

The completed moulds are placed on roller conveyors and are cast from lip-pour ladles suspended from the overhead cranes running down the full length of the shop from the steel-making bay. When the metal has set, the moulds are picked up by an overhead travelling pneumatic bumper and knocked out over a grid running underneath the ends of the casting conveyor lines. The hot castings are raked off the grid and placed at once in the adjacent slowly passing trays of a casting-cooling pendulum conveyor which is driven by a 2-HP, 935-RPM squirrel-cage motor, with transmission through a high-ratio reduction gear. The motor is started by a direct-on push-button operated air-break contactor starter in a cubicle at the end of the bay near the sand plant control gear, and the motor can be stopped in emergency by a trip switch should a casting tray inadvertently tip in its cradle. The conveyor passes out of the end of the building over the roadway outside and into the fettling shop, during which time the castings have become cool enough to handle.



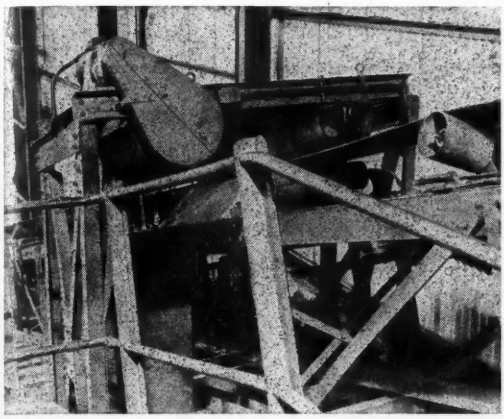


Above : The sand from the moulds falls on to a knock-out conveyor and the castings are transferred to the trays of a cooling conveyor. Left : The point at which the sand is transferred from the knock-out conveyor is the junction of three conveyors, the third one being that which brings surplus sand back from the fettling shop ; note drive for inclined conveyor

The hot sand knocked out from the moulds drops down through the grid flooring below on to a continuously moving belt conveyor, which operation is the first step in the recovery and eventual return of the sand to the moulding section. The knock-out conveyor is joined at the end of the shop by a return sand conveyor from the fettling shop from which a further quantity of sand is recovered in the first stage of cleaning the castings.

This returned sand then runs up an inclined belt, under a magnetic separator which removes tramp metal and into a rotary screen which removes lumps. The lumps are fed to a bin and rejected, while the remainder of the sand falls through the screen on to a

moving belt which transfers it to the buckets of an elevator. The elevator raises the sand to the top of a cascade tower down which it drops in stages, being first cooled and finally de-silted by air suction from an electrically driven fan.



Steel studs on the magnetic separator belt are magnetised at the point at which they pass immediately over the sand

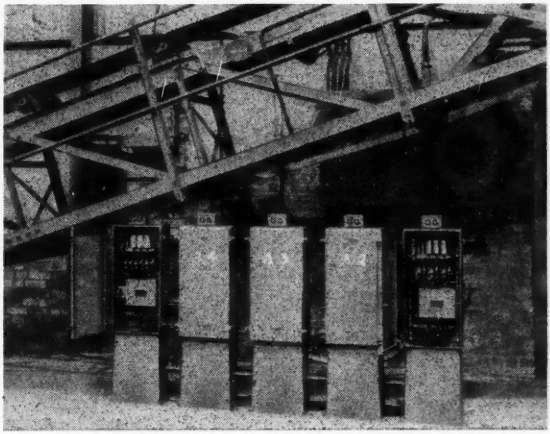
The silt is removed in the later stages by the fan which deposits it in a cyclone hopper outside the building, whence it is dumped into wagons for removal, by opening an electrically operated valve underneath. The de-silted sand from the bottom of this plant is then conveyed by a series of three belts to the mixer bin. The sand so reconditioned can be tapped off from either side of this bin into skips, where binders and some new sand are also added. The hoists operate automatically after the start button has been pressed and are controlled by limit switches so as to tip the contents of the skip and return back to the ground position.

The mixers are of the pan-mill type and are driven by slip-ring motors because of the high starting-torque requirements, and either or both mixers operate in electrical sequence with a common collecting belt underneath. Normally, when the mixer cover is lifted a switch opens the mixer control circuit, but as it is sometimes necessary to lift the cover for checking the mixture while running, the switch can be held down temporarily. For cleaning out or repair work, however, a separate isolator with a pilot light is provided nearby to enable the operator to safeguard himself by cutting off the mixer motor from its control panel without shutting down the remainder of the plant in sequence.

The products of the two mixers, having been collected by the common conveyor underneath, are distributed to the moulding machine bins by a conveyor running over the top of them. The sand is "ploughed" off this belt into the bins as required, and later it is fed to the machines below under the control of the moulders by short electrically driven belt feeders.

We have described the process as a whole without reference to the electrical features so that the reader may better understand the requirements which have to be met, and in the accompanying table we give a list of the drives in the order of the sand flow, showing the groups into which they are divided for starting in the correct sequence to prevent the material handled from piling up at any stage other than storage points.

All the motors are totally enclosed, fan-cooled machines, except the special small geared motors which are plain totally enclosed units and the number of sizes has



The control cabinets for all the motors in each of the sequence-controlled sections are grouped as one set of equipment

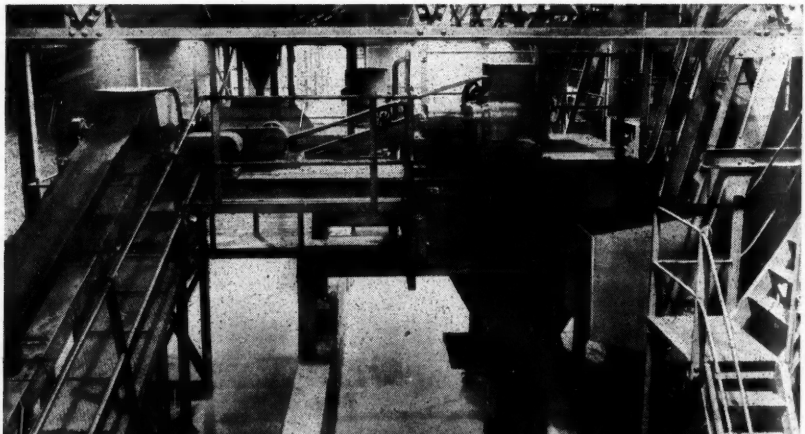
been kept down to the minimum. The control gear is of one design throughout, consisting of push-button operated air-break contactor panels in floor-mounted cubicles, each with an isolator and sequence interlocking contacts, with the exception of the independently controlled belt feeders in which the interlocking contacts are omitted. The panel for the casting cooling conveyor is of the same type, but it is not interlocked with the sand plant sequences.

For each s.r. motor the rotor resistances and contactors are combined in the stator cubicle and interlocked so that the retaining contactor in the sequence operates in conjunction with the last stage of the rotor resistance to ensure that the next drive in the group cannot be started until the s.r. motor is up to speed. To save complicated interlocking between the mixer skip hoists and the mixer drives the panels for the former are simply connected on the operating side of the respective mixer motor line contactors. By this method the mixer motor must be started first, but the hoist can thereafter work independently.

The panels are connected to separate circuits on the moulding section h.r.c. fuse

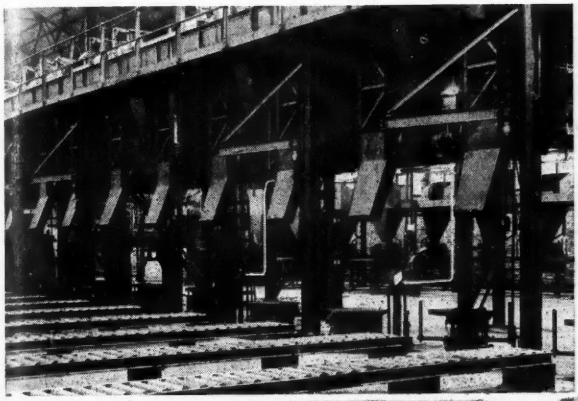
SAND RECOVERY AND TREATMENT PLANT

Plant Component	Motor Data			Starting Sequence	
	HP	RPM	Type	Group No.	Starting Order
Return fettling sand belt	5	715	s.c.	A1	e
Knock-out sand belt	5	715	s.c.	A2	d
Magnetic separator	½	100 GM	s.c.	A3	b
Inclined belt to screen	5	715	s.c.	A4	c
Screen	3	715	s.c.	A5	a
Belt from screen	½	15 GM	s.c.	B1	g
Elevator	3	715	s.c.	B2	f
Cooler and de-silting fan	45	1,455	s.r.	B3	e
Belt from cooler and de-silter	3	715	s.c.	B4	d
Belt No. 1 to storage bin	3	715	s.c.	B5	c
Belt No. 2 to storage bin	3	715	s.c.	B6	b
Rotary valve for dust hopper	½	15 GM	s.c.	B7	a
Charging skips to mixers (2)	7½	960	s.c.	C1-2	b
Moulding sand mixers (2)	30	1,440	s.r.	C4-5	a
Collecting belt from mixers	3	960	s.c.	D1	b
Distributing belt to bins	5	715	s.c.	D2	a
Belt feeders to moulding machines	½	15 GM	s.c.	E1-12	Ind.



The group of conveyors from the screen to the storage bins are all embraced in sequence control system B

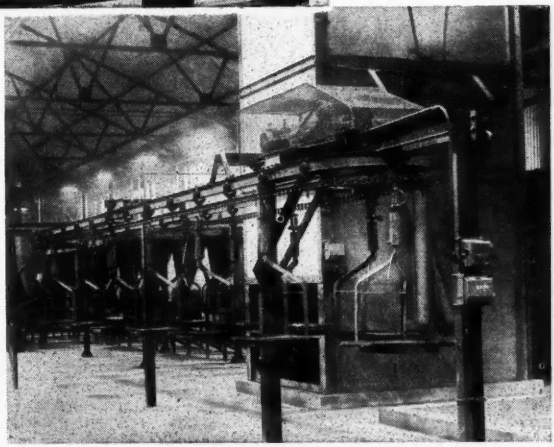
distribution board. The cubicles are mounted in sequence groups as near to the motors they control as possible, and interlocking connections are run in short conduits between the pedestals, thus making in all a neat and easily accessible lay-out for operation and maintenance. Every circuit, including the motor, control panel and distribution fuses, is numbered on an independent letter and number system to identify each set of equipment quickly throughout the whole works.



The motors driving the feeders serving the compressed-air operated moulding machines are controlled by pedal switches on the "dead man" principle

The magnetic separator consists of a short motor-driven belt with steel studs on its surface which, when magnetised by the DC magnet behind them, pick the metal particles out of the sand passing on the conveyor close underneath. The magnetic field is sustained over the length of the underside of the separator belt by the magnet coil and distributing core which are supplied with direct current from a local metal rectifier. The belt motor and the rectifier supply form one sequence unit.

To complete the foundry is a separate core-making section, consisting of a drying plant, mixer, core-handling conveyor and core-drying stove. The core sand is first delivered from railway wagons or lorries to floor bins whence it is collected in barrows and tipped into a miniature automatic electrically driven skip hoist which elevates it up a short incline into a hopper. The hoist is driven by a 3-HP, 715-RPM, s.c. motor served by a push-button operated air-break contactor panel, and is controlled by limit switches. From the hopper the sand is fed at a suitable rate by a rotating disc-type table feeder into a small rotary drying kiln fired by gas. The table is driven by a ½-HP geared s.c. motor, and the kiln by a 3-HP, 715-RPM s.c. motor, both being started by standard direct-on push-button air-break starters. The hot dry sand from the kiln is then discharged into a pneumatic conveyor which consists of a pipe line into which air is blown by a fan which also cools the sand in its passage to the far end of the line. The fan for this simple and ingenious machine is driven by a 20-HP, 1,420-RPM, s.r. motor which is controlled by a combined stator and rotor push-button operated air-break contactor panel.



A green-core conveyor passes the cores along to a drying stove; the conveyor motor is independently controlled and there are emergency stop push-buttons along the route

The core sand delivered by the pneumatic conveyor is stored in a hopper feeding a

small oil sand mixer mounted on a platform above the core-making tables. The mixer is driven by a 12-HP, 710-RPM, s.c. motor served by a local star-delta starter. The sand and oil mixture is distributed in barrows to bins above each core-making table.

The hand-made green cores are then placed on spring-suspended trays on a pendulum conveyor and transferred to the core-drying oven where they are baked.

A feature of the annealing furnaces is their withdrawable hearth, each of which is carried on a motor-driven bogie

The conveyor is driven by a 2-HP, 935-RPM, s.c. motor with a direct-on push-button starter placed conveniently on a supporting stanchion. There are also a number of push buttons on the route for stopping the motor in emergency. The core-drying oven is gas fired and consists of a vertical continuous chain to which are fixed a series of grids on which the trays of cores are placed. The moving train is driven by a 1½-HP, 945-RPM, s.c. motor served by a direct-on starter. The baked cores are taken to the coring-up stations in castor wheel trucks and there join the moulds at the roller conveyors opposite the moulding machines. Moulding sand, as previously stated, is brought to the moulds from the bins above the moulding machines, and the belt feeders are controlled by foot-operated push-buttons.

Fettling Shop

In the fettling shop the castings are fettled and finished by several methods according to their type and size. Heavy grinding is performed on double-ended floor grinders driven by internally mounted 12-HP, 1,450-RPM, high-torque s.c. motors. Nearby are tables fitted for pneumatic and "Hicycle" electric hand tools and a portable transformer welder outfit. In other parts of the shop are a shot blast equipment and a line of wheel-abrators. The former consists of a closed cabinet in which hard steel shot is blown at high velocity on to the castings by a fan driven by a 17½-HP, 1,400-RPM, s.c. motor. The shot is returned for use again by a bucket elevator with a 2-HP, s.c. motor.

The wheelabrators consist of enclosed rotary tumbling chambers into which the castings are fed by an automatic skip. The shot is projected on to the castings by high-speed impellers, the dust being drawn away by a suction fan. The 15-HP impeller wheel, 2-HP mill, 1-HP elevator and 5-HP loader motors are controlled from a single group-control push-button operated air-break contactor unit. A separate 10-HP fan is provided to exhaust dust.

The finished castings are passed to a pair of gas-fired bogie annealing furnaces. The bogies are operated electrically by a 10-HP, 940-RPM, s.r. motor served by a tramway-type drum controller. Either bogie can be coupled to the withdrawal mechanism by dog clutches and maximum travel either way is controlled by limit switches. The bogies are prevented from being withdrawn when the furnace doors are shut by simple door limit switches.

Compressor Equipment

To provide gas for the various uses a battery of suction gas producers is installed at one end of the fettling shop, while for compressed-air for services mainly in the foundry is a compressor house alongside the fettling shop with three electrically driven compressors. The larger unit is driven by a 215-HP, 428-RPM synchronous induction motor. The other two compressor motors are 112-HP, 960-RPM equipments of the same type.

The compressor motors serve to provide the power factor correction for the factory. In the same house is the frequency changer for the "Hicycle" tools and fettling-shop main distribution board.

There is a separate block of buildings housing the engineering shop, pattern shop, electrician's shop and stores, all equipped with modern electrically driven tools.

Our thanks are due to H. A. Brassert & Co., Ltd., who designed the factory, for their assistance in the preparation of this and the previous article.

Engineers of the Future—III

Apprentice Training

How the British Thomson-Houston Scheme Operates

By H. Warren,
M.Sc., M.I.E.E.
(Director of Research, B.T.H. Co.)

I WAS glad to accept the invitation to write something about the British Thomson-Houston Co.'s arrangements for training young engineers. For almost half a century the company has been recruiting young people from the various educational sources ranging from the elementary schools to the universities ; for over thirty years it has had an Apprenticeship Committee studying and controlling training in the organisation. Thousands of apprentices have passed through the courses to take up technical positions in the company, to go to customers and other friends, and to fill teaching, government and other appointments in all parts of the world. There are approximately a thousand indentured apprentices in training at the present time, and nearly five hundred serving apprentices are with the forces.

Apprenticeship Committee

The Apprenticeship Committee is an authoritative body made up of senior research, engineering, manufacturing, commercial and accounting officials who are trainers of apprentices and employers of ex-apprentices in their departments. It has a full-time chairman and secretary; the chairman is responsible to a director, who reports apprenticeship matters regularly to the board of directors. The managers of the various works are represented on the Committee, whose apprentice training policy is executed without question by the resident apprentice supervisors reporting to the managers.

The terms of reference of the Apprenticeship Committee, laid down by the chief engineer, are as follows :—" To study continuously and to regulate the selection, education, training, general conditions of employment, rates of pay, post training, placing and other conditions relating to the educational, vocational, and cultural development of young people, male and female, in the employ of the company."

The main Committee meets quarterly, Numerous sub-committees meet more frequently, and the branch factories have local committees which are presided over by the chairman of the main Committee. In this way is maintained a co-ordinated educational policy throughout the organisation.

The following are some points of the apprenticeship system which may be particularly mentioned :—The prime importance attached to it; careful selection of candidates; close collaboration with the educational sources of recruitment and with educational establishments in which part-time training may be continued ; the planning of courses to suit the characteristics and desires of the trainees as well as the requirements of the organisation ; provision of opportunity of promotion from the trade to the student courses ; and attention not only to vocational training, but also to the development of initiative and of social and recreational activities, and, finally, to the effective "placing" of the finished apprentices.

Details of Courses

Trade apprentices are first engaged as shop lads at fourteen to sixteen years of age on leaving the elementary, central, junior technical, or secondary schools. The course, commencing at the age of sixteen, is of five years' duration, and boys are taught trades such as pattern making, foundry work, tool-making, fitting and assembly, machining and turning, electrical fitting, etc. They are encouraged to attend the local college, and may secure National Certificates with the aid of day and evening classes; they may qualify for upgrading. Usually ninety or a hundred trade apprentices are taken annually.

Drawing office apprentices are recruited at the ages of sixteen or seventeen, following secondary or junior technical school education, leading to the school leaving or junior technical school certificate. The course extends to five years and is designed to train draughtsmen. Experience is acquired in the shops, offices, and drawing offices, and there is concurrent college attendance providing opportunity for securing National Certificates. About sixty drawing office apprentices are taken each year.

Engineering apprentices commence at seventeen years of age with qualifications equivalent to matriculation. They originate from the public or secondary schools, and are selected on their head masters' recommendations and by personal interviews. The course is of five years, and includes college attendance at day

and evening classes—preparing for the National Certificates, or for the external London degree. These youths are trained to become research, designing, manufacturing, or commercial engineers, and those who graduate automatically become student apprentices. Normally some seventy engineering apprentices are recruited every year.

Student apprentices are university graduates, of about twenty years of age, selected in collaboration with their teachers, and by interview at the college and at the works. The duration of the course is three years ; its variations are planned to suit individuals and include shop, test, drawing office, design office, laboratory, and commercial office experience, calculated to produce research, designing, manufacturing, or commercial engineers. In ordinary times about fifty student apprentices are taken each year.

These four are the principal apprenticeship courses, but there are also testers, chemists, works office, and clerical courses ; pre-apprenticeship vacation, and post-apprenticeship works administration courses. Also, tracers, typists and stenographers are trained.

Members of the technical staff give lectures in the works to apprentices nearing the end of their courses. These lectures are intended to keep the trainees up to date in modern developments, and to portray to them the kind of work done by the various technical departments.

Student and engineering apprentices are invited to discuss their training itineraries with the apprentice supervisor, and individual training courses are arranged. Apprentices showing appropriate capacity are entrusted with minor positions of authority in the shops, as an outlet for the development of the supervisory faculty.

College Attendance

As regards pre-apprenticeship years, in Rugby all young people between the ages of fourteen and sixteen attend the day continuation school one day per week. During apprenticeship, day-time college attendance of half-a-day to one-and-a-half days per week with pay (according to the college course taken) is allowed. There may be also three evenings per week devoted to college work.

The Rugby works training schemes are planned and operated in close co-operation with the Rugby College of Technology and Arts, which is a first-class technical college under an enlightened governing body and an exceptionally capable and progressive principal. Members of the company's technical staff serve on the local Education Committee and the Engineering Advisory Committee ; the company's engineers do much of the engineering evening class teaching. There are special advanced tutorial classes conducted in the works.

Awards are made to trainees in recognition of praiseworthy industry and study. They are based upon periodical reports from foremen and from the College, and take the form of pay increases, of special experience in desired departments, and of promotion to courses leading to higher positions.

Broader Issues

In normal times fellowships are awarded annually to one or two ex-apprentices. They provide for a year's special training in the United States, designed especially to equip the students for the particular lines of engineering that they intend to make their careers.

There is a self-supported Apprentice Association, an Apprentice Hostel, Recreation Club, and Overseas Association. There are keep-fit classes, art, literary, and handicraft competitions. The annual "rag" in aid of the hospital is a most impressive and successful affair of the apprentices.

Many years of contacts with a changing panorama of trainees and their teachers have provided much to learn and much to be studied as a vital phase of the varied vista of

Machine section of apprentice training room

industrial research. New blood and new knowledge are imperative requirements of industry—especially of such a young industry still evolving from the experimental laboratory and from the field of adventuresome experience.

We owe much to the professors and teachers of the universities, colleges, etc., whose interest and collaboration are obviously of tremendous importance in industrial training; it is well appreciated that this academic and industrial co-operation must be developed and strengthened. As between our trainees and ourselves there is a most gratifying common interest and loyalty, and we realise our mutual indebtedness.

Club room at apprentice hostel

General problems of the future will be to tighten up relaxed standards of education and training; to adjust our systems of receiving, developing and placing young people to meet their higher school leaving ages and their facilitated education, and to make accommodating arrangements to complete courses interrupted by national service.

There is to be progress in the scholastic education of young people, some of whom are destined for industry; there must also be progress on the part of industry in providing the young people with the best possible opportunities of further developing their faculties.

Forthcoming Events

Friday, March 31st.—*London.*—At Institution of Electrical Engineers, 5.30 p.m. Measurements Section. Discussion on "The Consumer's Supply Control Unit of the Future, and its Effect on the Design of the Electricity Meter," to be opened jointly by Messrs. E. Fawssett and G. F. Shotter.

Saturday, April 1st.—*Bristol.*—At Merchant Venturers' Technical College, 3.30 p.m. I.E.E. Bristol Students' Section. "Automatic Features in Generating Stations," by Mr. F. H. Guzdar.

Manchester.—16, St. Mary's Parsonage, 2.30 p.m. Junior Institution of Engineers (N.W. Section). "Design of Switchgear Operating Mechanisms," by Mr. H. H. Daniels.

Monday, April 3rd.—*London.*—At Institution of Electrical Engineers, 7 p.m. London Students' Section. "Motor Coach Trains and their Operation on British Suburban Railways," by Mr. B. J. Prigmore, B.A.

London.—At Austrian Centre, 69, Eton Avenue, N.W.3, 7.15 p.m. Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain. "Modern Trends in Electrical Insulation," by Mr. J. Rubinstein (research engineer, Ferguson, Pailin, Ltd.).

Birmingham.—At James Watt Institute, 6 p.m. I.E.E. South Midland Centre. "Restriking Voltage as a Factor in the Performance, Rating and Selection of Circuit-breakers," by Messrs. J. A. Harle, M.Sc., and R. W. Wild; and "Influence of Resistance Switching on the Design of H.V. Air-blast Breakers," by Messrs. H. E. Cox and T. W. Wilcox.

Chester.—Corporation Electricity Showrooms, 22, Northgate Street. I.E.E. North Western and Mersey Centres and Chester Engineering Society. "Standardisation in Great Britain of Single-Circuit Overhead Lines up to 33 kV," by Messrs. H. Willott Taylor and K. L. May.

Sheffield.—Central Library, Tudor Place, 6 p.m. Illuminating Engineering Society, Sheffield Centre. "Post-War Planning of Lighting in Dwellings and Public Buildings," by Mr. J. T. Grimshaw.

Leeds.—Corporation Electricity Showrooms, The Headrow, 5.15 p.m. I.E.S. Leeds Centre. Paper on "Lighting in the Tailoring and Garment Making Industry."

Tuesday, April 4th.—*Coventry.*—Corporation Electricity Showrooms. Coventry Electric Club. "Post-war Planning," by Mr. D. E. E. Gibson (city architect).

Derby.—Electricity Showrooms, Irongate, 6 p.m. I.E.S. Derby Group. Address by the president.

Wednesday, April 5th.—*London.*—At Institution of Electrical Engineers, 5.30 p.m. Wireless Section. "Energy Conversion in Electron Valves," by Dr. Ing. D. Gabor.

Birmingham.—At James Watt Institute, 6.30 p.m. Junior Institution of Engineers. "Engineering in America," by a member of the American Armed Forces.

Thursday, April 6th.—*Newcastle-on-Tyne.*—Minor Hall, Oxford Street, 5.30 p.m. I.E.S. Newcastle Centre annual meeting.

Insulation Tracking

Simple Testing Methods and Results

By W. A. McNeill, B.Sc.Tech., A.M.I.E.E.
and J. Rubinstein

THE formation of carbonised conducting paths on insulation surfaces presents a number of problems, both regarding the nature of the phenomena and suitable methods of testing. The resistance to tracking must usually be taken into account when selecting suitable insulating material and we have, therefore, devised a testing technique which is simple to apply, and yet gives a reasonably comprehensive indication of anti-tracking properties.

There is some confusion regarding the correct terminology for this phenomenon and terms like "tracking," "treeing," "creepage," or "arc resistance," are often used for the same phenomenon. In BS. 738/1937 the term "tracking" is used when "the spark due to the normal rupture of the current impinges upon the insulation" and a footnote in the same specification suggests that the term "treeing" should be used with reference to the progressive deterioration of the surface of insulating materials by electrostatic discharges. In addition "an arc resisting material" is defined as one which resists the action of an electric arc, or very high temperature flame.

Fig. 1.—Typical example of tracking as it occurs under adverse conditions

For the purpose of describing the testing technique which has been developed "tracking" is used for every type of carbonised path between the electrodes irrespective of its degree of carbonisation or of its origin. The discrimination between "treeing" and "tracking" according to degree of carbonisation is unsatisfactory owing to the difficulty of determining where "treeing" ends and "tracking" commences. A typical example of tracking as it occurs under adverse conditions is shown in Fig. 1. No discrimination has been made between the two possible causes, because an electrostatic discharge is always connected with heat generation and eventually results in carbonisation.

Tests suggest that track formation is caused by the accumulation on the surface of electrolytic impurities from the air which, together with moisture, form a conducting film between current carrying parts. Heat generation by the creepage current causes evaporation of the water, resulting in formation of a small gap across the creepage path. Electrostatic forces also have an effect in the formation of the gap. If the latter is small enough and the voltage drop across it sufficiently great, a minute arc will occur which will char the surface, and the carbonised spot will act as a new electrode. Although the location of the arc will be somewhat fortuitous, depending on such factors as the conductivity of the film and current density, experience has shown that it will occur where the field is strongest and where the accumulation of impurities is greatest. It is known that the latter factors are interdependent, impurities being attracted to points of high field concentration.

It is, therefore, understandable that the first minute spark will start at a place of high field concentration near the electrode and will move forward, often branching off, carbonising the surface and leaving a charred track which acts as an extension of the electrode. The direction of movement will depend, of course, on the creepage current path, the speed of movement, however, being a function

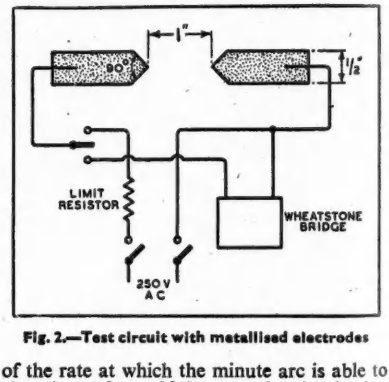


Fig. 2.—Test circuit with metallised electrodes

of the rate at which the minute arc is able to char the surface. If the rate of carbonisation is slow, the rest of the conducting film may evaporate, or extend the gap in such a way that the insulation resistance between the electrodes is sufficiently restored to interrupt

the creepage current and, therefore, prevent the completion of a carbonised path. The speed with which a track is completed is therefore an indication of the resistance of the surface against tracking. Based on these considerations the low voltage test described below has been developed.

Description of Tests

(a) *Low Voltage Test.*—In order to preselect the starting point of the track, pointed electrodes of the shape shown in Fig. 2 were used. They were metallised on the surface of the insulation material to be tested and leads soldered to them. This method has the advantage that the test can be carried out single handed and, moreover, avoids the possibility of air gaps between the electrodes and the surface. A distance of 1 in. between electrodes was found to be suitable.

The conducting film was reproduced by a concentrated saline solution mixed with glycerine in equal parts by volume to avoid unduly rapid evaporation. Application to the surface of the test piece was facilitated by a prior application of wet soap. This procedure also allowed the film to be confined to a definite area, a width of 0·5 in. being chosen.

The initial creepage current is, of course, determined by the amount of liquid put on the surface and this must, therefore, be standardised. It was found impracticable to keep the current constant during the tracking process and a simple method of control was obtained by the direct measurement of the film resistance with a Wheatstone bridge. Liquid was added to the surface and a resistance value of 2,500 ohms was obtained. By this means the use of complicated apparatus to determine the exact quantity of liquid applied was avoided and there was no uncertainty as to the actual initial creepage current. Care was taken to ensure that the surface was in a horizontal position to obtain a uniform thickness of film.

An applied voltage of 250 V AC gave the best results. In addition a limiting resistance was included in the circuit to enable the short-circuit current to be limited to 10 A immediately on completion of the track. Comparative values of surface resistance to tracking can readily be obtained by the method described for various insulating materials by recording the time taken from initial application of voltage to completion of the track (Fig. 3A). For materials which are highly resistant to tracking a continuous track was not always obtained at a resistance value of 2,500 ohms and in certain instances the resistance was lowered to 1,000 ohms before a complete track was formed. For materials having exceptional anti-tracking properties even this value may be too high.

The above method of testing gives a reliable indication of the anti-tracking properties of materials, because it imitates to a considerable degree the actual conditions under which tracking can occur and at the same time permits reasonable standardisation of testing conditions.

(b) *High Voltage Testing.*—For certain applications insulation may not be continuously subjected to voltage stress, but may be stressed at frequent intervals for short durations. For such applications the test described above may not correspond exactly to service conditions and so samples were repeatedly subjected to a voltage sufficient to cause flashover, the anti-tracking quality of the insulation being then judged by the number of flashovers required to produce a continuously carbonised path. Tests on somewhat similar lines have been carried out by other investigators (see ref. 4).

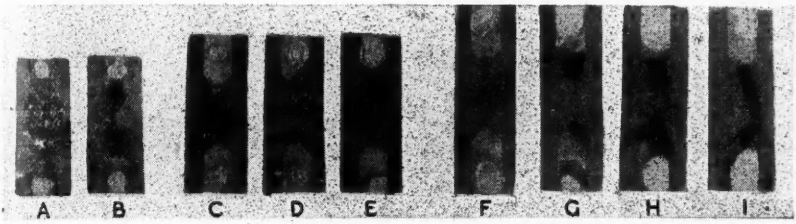


Fig. 3.—Typical test results at low and high voltages

Test samples with metallised electrodes were again prepared as described for the previous test, but the test surface was now arranged vertically with the electrodes one above the other. The position is important because of the tendency of convection currents to influence the proximity of the arc to insulation surface.

The voltage was raised at the rate of 5 kV per minute until flashover occurred. In order to prevent the arc being maintained, regulation of the voltage by means of a choke was provided, the core being automatically withdrawn as soon as flashover took place.

After 15 seconds the voltage was again raised at the same rate and the procedure repeated until the carbonised path was completed between the electrodes (Fig. 3B). The

number of flashovers gives an indication of the anti-tracking properties of the material.

The reaction of varnish to this test is also illustrated. Fig. 3 C, D and E apply to unvarnished resin bonded paper board showing the results after 1, 3 and 5 flashovers respectively, while Fig. 3 F, G, H and I illustrate the results obtained on a similar board with a varnish finish after 1, 5, 10 and 15 flashovers. For Fig. 3 (C, D and E) the flashover voltages were 18 kV, 12 kV and less than 5 kV respectively, the last four samples corresponding to voltages of 18, 15, 10 and less than 5 kV.

The tests described have the advantages that they are simple to carry out and yet give consistent and reproducible results. Results obtained have been in all cases based on the average of ten tests and experience has shown that the variation between individual tests has been small. When testing a variety of materials, however, account must be taken of the nature of the material. For example, the tracking resistance of fibrous materials varies considerably, depending on whether the tests are carried out across or along the grain.

The thermal conductivity also has an influence on the result and the thickness of the test strip must, therefore, also be taken into account. The latter factor is of special importance when tests on varnishes are carried out. For the flashover tests some skill is required to limit the duration of arcing and also to ensure equal time intervals between flashovers.

It is difficult to express quantitatively the relative significance of the two methods of test and for a given insulation material the particular application should be taken into account. Both methods of testing may be used with advantage and complementary results obtained.

The authors are indebted to Messrs. Ferguson, Pailin, Ltd., for permission to publish details of this investigation.

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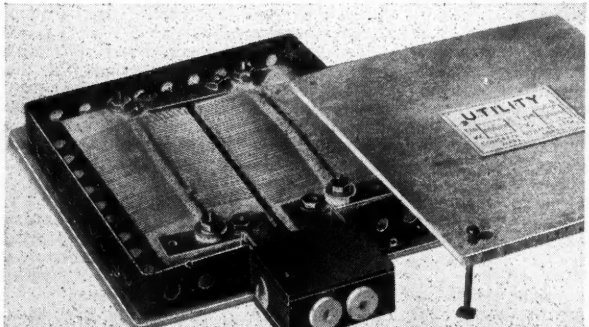
Heater for Feeder Pillars

WITH the shortage of carbon filament lamps, many electricity undertakings are finding difficulty in dealing with condensation in feeder pillars. In collaboration with the Walthamstow Electricity Department, Concrete Utilities, Ltd., Great Amwell, Ware, Herts, have designed a compact heater for the purpose, which seems to be dealing effectively with the problem.

Measuring overall only 7½ in. by 5½ in. by 1⅛ in., the unit needs little space for its accommodation. The terminals are easily accessible. The elements, which are available with loadings of 40, 60 and 80 W, are wound round strips of ¼ in. thick non-hygroscopic electrical asbestos, the wire being kept slightly raised in the centre by small tubes of asbestos inserted at each side. The casing is also of asbestos and a perforated metal spacing piece allows a current of air to pass through the elements. The elements provide a temperature rise of 60/70 deg. F., running at a black heat of about 140 deg. F. (dependent on the ambient temperature), which, being only about one-sixth of their rated operation temperature, ensures a long life. The heaters carry a twelve months' guarantee. About a hundred of the units are now in successful operation at Walthamstow, and several other undertakings have also adopted the idea.



Heater for overcoming condensation in feeder pillars

PERSONAL and SOCIAL

News of Men and Women of the Industry

ON March 14th **Dr. Anton F. Philips,** co-founder and head of the Philips radio and electrical organisation, celebrated his seventieth birthday.

Speaking at an interview, Dr. Philips expressed great pride in the effectiveness with which the Philips factories in the British Empire and the United States and other free countries had been able to contribute to the war effort. He added that his full energies were being directed to the employment of his companies' resources in the cause of victory.

Dr. Anton Philips

Dr. Philips was born at Zaltbommel, Holland. At the age of twenty he joined his elder brother Gerard to look after the affairs of the carbon-filament lamp manufacturing business which the latter had established in 1891 at Eindhoven with his father's financial backing. With the development of the organisation new interests were added, including radio and X-ray apparatus production and the scope of the business extended all over the world. Although the Philips major assets at Eindhoven are now under German control, many important parts of the organisation are still working for the Allied Nations, including the British and American Philips Trusts, and factories operating in England (15,000 employees), North America, South America, Australia and India. Dr. Philips is at present in the United States.

Staff-Sgt. J. M. Shannon, Royal Engineers, who is mentioned for gallant and distinguished services in the Middle East, is an electrical engineer and formerly was with the Paisley Corporation Electricity Department. For a number of years he has been outside representative for the Simplex Electric Co., Ltd.

Mr. T. R. Warren, M.A., B.Sc., A.M.I.E.E., has taken up duty as the Central Electricity Board's technical engineer for the Central and South Scotland Areas, following the recent appointment of Mr. John Henderson to the staff of the Ayrshire Electricity Board. Mr. Warren previously held a similar appointment in the North East England Area, which has now been merged for administrative purposes with Mid-East England. **Mr. W. T. J. Atkins,** B.Sc., M.I.E.E., technical engineer for Mid-East England, has been appointed technical engineer for the combined areas.

Sir Robert McLean has resigned from the position of managing director of Electric & Musical Industries, Ltd., and its associated companies.

Mr. W. R. Goodier, who has been confirmed in the position of general manager of the Wallasey Corporation omnibus undertaking, having been appointed in an acting capacity last year, had an electrical training with Dick, Kerr & Co., and later with the English Electric Co., with whom he was engaged in the design of traction motors and control gear. He became electric traction engineer in the company's tramway department and later contracts engineer at the vehicle body and chassis works. In 1937 he was appointed assistant engineer in the Blackpool Transport Department.

Mr. J. A. R. Wood has been appointed mains superintendent (with charge of substations) by the Mexborough Electricity Committee, as from May 22nd.

Capt. B. H. Peter has resigned his position as Board of Trade representative on the South-Western Regional Board and is succeeded by **Mr. Barry Kay,** Regional Controller of Factory and Storage Premises.

Mr. W. N. Ringrose has been appointed by the Electric Construction Co., Ltd., as representative for the whole of Scotland, in succession to Mr. James Doe. Since 1929, Mr. Ringrose has been an engineer-representative of the E.C.C., covering various parts of Great Britain from the Wolverhampton works. He is retaining the present office at 170, Hope Street, Glasgow, C.2. (Telephone: Glasgow, Douglas 1704.)

The Thornton Cleveleys Urban District Council is retaining the services of **Mr. A. G. Cooper,** electrical engineer, for a further twelve months from March 31st.

Mr. P. J. Robinson, who recently retired from the position of city electrical and lighting engineer of Liverpool, received gifts from the staffs of the Electric Supply and Street Lighting Departments on March 22nd. The presentation,

Mr. E. L. Morland (right) making a presentation to Mr. P. J. Robinson on his retirement

which took place in St. George's Hall, included a cheque, wallet and inscribed silver plaque recording their regard and esteem for him. Mrs. Robinson received a diamond clip brooch.

Mr. E. L. Morland, superintendent engineer of distribution, presided. Unanimous good wishes to Mr. and Mrs. Robinson for long life and happiness were duly accorded. They have taken up residence in Deganwy, North Wales.

Mr. L. W. Welch has been appointed assistant chief engineer to Central London Electricity, Ltd., as from January 1st, 1944.

Mr. J. J. Lesser (City of London Electric Lighting Co., Ltd.) has been elected chairman of the South East and East England (Greater London) Area of the British Electrical Development Association, with **Mr. J. R. Jones** (Hammersmith) as vice-chairman. **Mr. H. Dixon** (Central Sussex Electricity, Ltd.) is the new chairman, and **Mr. J. B. Morgan** (East Grinstead) vice-chairman of the Southern Committee of the Area and, as already reported, the chairman and vice-chairman for the remaining (Eastern) part of the Area are **Mr. A. Wade** (East Suffolk Electricity Distribution Co., Ltd.) and **Mr. G. P. Dixon** (Colchester).

The London Students' Section of the I.E.E. held a dance at the Lysbeth Hall, Soho Square, on March 18th, when over 110 members, friends and guests were present. The dance proved to be a great success and everybody present thoroughly enjoyed the evening.

Mr. H. M. Longridge retires this week from the position of general manager of the British Engine, Boiler & Electrical Insurance Co., Ltd., which he has held since January, 1915. He is succeeded by **Mr. R. R. Mason,** sub-manager of the company.

Mr. R. H. Scholes and **Mr. W. J. R. Thomas,** employees of George H. Scholes & Co., Ltd., for a considerable period, have been elected directors of the company.

Mr. S. S. Lamert is retiring from the chairmanship of Thomas De La Rue & Co., Ltd., but is to remain a director. He is succeeded by **Mr. B. C. Westall** as chairman and managing director.

Mr. R. O. Ackerley (General Electric Co., Ltd.) recently addressed a meeting of the Belfast and Northern Ireland Association of Engineers and the Northern Ireland Sub-Centre of the Institution of Electrical Engineers in the College of Technology, Belfast, on the subject of fluorescent lighting, which, he said, would be one of the great developments of the future, provided that its limitations were understood.

Miss M. C. M. Thyne, of the Metropolitan-Vickers Electrical Co., Ltd., gave an address on "Welding Development," to the Manchester Branch of the Women's Engineering Society on March 17th.

Miss I. M. Bovey, secretary of Falk, Stadelmann & Co., Ltd., who has been with the company for forty-two years, retires this week. **Mr. F. H. P. Parker-Harding** succeeds her.

Obituary

Mr. J. Poole.—The death occurred on March 22nd at Bowes Park, at the age of ninety, of Mr. Joseph Poole, A.M.I.E.E., Wh.Sc., whose book, "The Practical Telephone Handbook" (Pitman), is familiar to generations of telephone students. The book is still regarded as a standard work on the subject and it was only last year that the eighth edition was published, the term "Practical" being then dropped from the title. Mr. Poole was with the National Telephone Company before the telephone service was taken over by the Post Office.

Commander J. A. Slee.—The death occurred on March 20th at Streatham of Commander John Ambrose Slee, C.B.E., M.I.E.E., R.N. (retd.), technical consultant of the Marconi International Marine Communication Co., Ltd., and formerly joint general manager of the Marconi Sounding Device Co. Commander Slee, who was in his 66th year, was educated in H.M.S. *Britannia* and on joining the Royal Navy specialised in signalling, being one of the pioneers in radio-telephony and telegraphy. During the last war he was chairman of the Wireless Telegraphy Board of the Royal Navy. He joined the Marconi International Marine Communication Co. in 1920 and acted as its representative at various international radio-telegraph conferences, including those at Washington in 1927, Madrid in 1932 and Cairo in 1938. He was a past-chairman of the I.E.E. Wireless Section. Commander Slee leaves a widow to whom we extend our sympathy.

The late Commander J. A. Slee

The cremation on March 23rd was attended by a number of representatives of the Marconi companies.

Mr. Robert Waycott, who died last week at the age of eighty-eight, was a director of the Paignton Electric Light & Power Co., Ltd.

Mr. J. Clifford Rowe, a director of the Para Electric Tramways & Lighting Co., Ltd., died on March 21st at the age of seventy-two.

Parliamentary News

Fuel Advisory Council

IN the House of Commons this week Major Lloyd George, Minister of Fuel and Power, told Sir Herbert Williams that he proposed shortly to appoint a Fuel Advisory Council to advise him on certain major technical and economic problems of fuel and power production and utilisation. Within the limits imposed by war conditions his Department had been at work on these problems and a volume of valuable information had been collected. His intention was that the Council should consist of a small number of experts in science, economics and industry. It would not have executive or regulatory functions, but he felt sure that it would render valuable services, especially during the reconstruction period.

Scottish Hydro-Electric Projects

It was announced that projects numbering 102 with a potential average annual output of more than 6,274 million kWh were listed in the development scheme of the North of Scotland Hydro-Electric Board which had now been approved by the Electricity Commissioners and confirmed by the Secretary of State for Scotland.

CORRESPONDENCE

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for correspondents' opinions.

Occluded Gases

MR. V. WALKER'S article in your issue of March 17th is a timely contribution to the all too scarce information on the subject of ammonia corrosion. Mention is made of the number of cases that occur in which ammonia may be formed from the decomposition of organic matter, nitrates or nitrites in the raw water. There is another possible source often unsuspected, namely, the drinking water supply when town's main water is used as a source of make-up. Due to present day exigencies many of these supplies are being heavily chlorinated and, to mask the taste, ammonia is used with the chlorine at the rate of two to one. Appreciable amounts of ammonia can therefore enter the system from this source.

It is to-day possible to remove ammonia by demineralising the raw water, also called "cold distillation" process, which produces a water similar to distilled water, without the application of heat, by removing the salts normally occurring in natural waters. Amongst these salts, ammonia is also removed. This process has been installed in several power stations, the resultant water being used as make up, and fed to high-pressure boilers without evaporation. A. J. R. WALTER,

London, W.4. A.M.I.Mech.E.

Electricity Supply Reorganisation

AFTER reading Mr. Carr's letter in your issue of March 17th, it appeared obvious to me that he was not fully conversant with the position and I would therefore bring the following facts and observations to his notice:—

(1) I hardly think it reasonable to suggest that I ought to have taken the trouble to obtain the views of the "majority" of selected station owners before the I.M.E.A's proposals were issued. Surely the representatives of the selected stations who comprise more than half the members of the Special Committee, were in a position to speak for the selected station owners as a whole.

(2) The Interim Report on Post-War Planning, which was unanimously approved by the Special Committee and confirmed by the full I.M.E.A. Council held at Lincoln on September 17th, 1943, contained the following recommendation: "That subject to suitable protection, all generating stations should be transferred to the Central Electricity Board, who will be responsible for the management of generation and the supply of current at the terminals of authorised undertakers—the Board to be responsible for all transmission up to that point."

(3) In view of (2) above and the lapse of six months since the issue of the Interim Report, the selected station owners had every opportunity to put forward their views for the consideration of the Special Committee.

(4) So far as concerns Mr. Carr's comment on the voting power on the Council of the selected station owners and of those not owning a generating station respectively, this does not appear to me to be relevant in the case of the Joint Memorandum, which was approved unanimously by all sections of the Council, but in any case, rightly or wrongly, our rulers in this country are selected on the basis that the vote of the millionaire counts exactly the same as the vote of the farm labourer.

As regards your correspondent "A. De-Bunker"—whose *nom de plume* might, I suggest, appropriately have had the letters "J.E." prefixed, I consider that the views of anyone who, in a matter of such vital importance to the whole industry, has not the courage to sign his name might well be ignored. The only comments I would make are:—

(a) That destructive criticism alone is easy matter but serves no useful purpose; constructive criticism would be welcomed.

(b) "De-Bunker" suggests that "I" should try again, as I am not the owner of a selected station. May I point out that the Joint Memorandum was unanimously approved by both the I.M.E.A. Council and the Special Committee responsible for its preparation and that many of the most eminent owners of selected stations—engineers and laymen—are members of these two bodies. In spite, therefore, of "De-Bunker's" wholesale condemnation of the Memorandum, I feel proud to have been associated with those responsible for putting it forward as a genuine attempt to confer on the consumer substantial and lasting benefits,

Newcastle-under-Lyme. A. J. C. DERENZI,
Engineer and Manager.

Standards for Turbine Oils

A WAR Emergency revision of B.S. 489-1933 Turbine Oils, has been issued. The revision affects the table of grades, and two new grades are now included, alternatives to the existing heavy and extra heavy grades with a lower cold test. A modification has also been made to the method of test for deleterious sulphur. Copies of this revision slip (Reference P.D. 211) may be obtained gratis on receipt of a stamped, addressed envelope, from the British Standards Institution, Publications Department, 28, Victoria Street, S.W.1.

Water Power in Eire

Liffey Scheme in Partial Operation

IN the course of a lecture to the Institution of Civil Engineers of Ireland on March 6th Mr. J. A. O'Riordan, chief engineer (civil works), Electricity Supply Board, revealed that the Liffey (Poulaphouca) plant is now operating. He was dealing mainly with the control and performance of the Shannon Scheme and stated that, apart from some small undertakings in areas not covered by the Board's transmission network, the Ardnacrusha power station and the auxiliary steam power station at the Pigeon House had provided electricity for Eire from 1930 up to the last few months when the Liffey hydro-electric project was put into partial commission. The completion of the mechanical and electrical equipment of the Liffey works had unfortunately been much retarded by present emergency conditions, he said.

Having reviewed the existing method of control of the River Shannon for power production, he showed in a table covering the twelve years from 1931-32 to 1942-43 that the total average annual production of the whole supply system was 303 million kW, of which amount 212 million kWh (70 per cent.) was produced at Ardnacrusha and the remaining 91 million kWh from steam. The Shannon Scheme had been of exceptional value during the emergency. For the four years from 1939 to 1943 the total average annual production was 462·5 million kWh of which 250·5 million kWh, or just short of 60 per cent., was produced at Ardnacrusha. A curtailment of the supply during periods of low flow (to the extent of about 10 to 15 per cent. of the demand) had been necessary, but the rationing was so arranged as to avoid any serious interference with the country's essential industrial and domestic requirements.

Variation in Output

The output at Ardnacrusha varied from year to year according to the amount and distribution of the flow and the demand on the system. In the earlier years the demand had not been such as to require the maximum available output, but the position was now being approached at which the total output up to the maximum capacity of the installed plant could be usefully employed, except at night in time of floods. The expectations of the experts who reported on the original Shannon Scheme had been more than fulfilled; the first stage of the projected load development was actually attained in the second year instead of the third, and the second stage in the sixth year instead of the seventh. The total demand had now far outstripped anything that could have been projected in any detail when the project was under consideration and the fears expressed in many quarters that the country could not consume the output of Ardnacrusha, at least for a very long time to come, had proved groundless.

In the original report of the experts on the Shannon Scheme the Liffey development was anticipated as a possible valuable compensating system for the full development of the Shannon. Since 1932, to keep pace with the growing demand, the generating plant had been increased by a further development of the Shannon, an increase in the capacity of the steam plant at the Pigeon House, and the hydro-electric development on the upper River Liffey.

Speaking of Irish rivers in general, Mr. O'Riordan said that the performance of the Shannon Scheme during the past fourteen years pointed to the possibility of meeting the future electrical requirements of the country by means of further hydro-electric developments combined with a judicious development of auxiliary steam power. A hydro-electric project was a long-term investment and in his opinion it was important, especially in Eire, which was only moderately endowed with potential sites, that all hydro-electric projects should be laid out to make provision for the eventual use of the maximum possible output from the river as distinct from looking for the cheapest possible block of units for meeting more immediate requirements. For that reason in the design of a scheme it was desirable to provide the widest possible latitude, subject to reasonable economy, for the future expansion of the scheme up to the maximum available output.

Bombay Supply Companies

Criticism of Local Authorities

THE annual report of the Association of Electrical Undertakings, Bombay Province, for the year ended August 31st last, records an intensification of the difficulties of the industry through increased expenditure, shortage of supplies, rationing and Government control. The inability of the companies to recover the increased costs from consumers has resulted in the latter, particularly local authorities, benefiting at the expense of the supply companies, and efforts have been made to persuade the Government to appreciate the inequity of this state of affairs.

Some outspoken remarks on this subject were made by Mr. V. F. Noel Paton, president, at the annual meeting of the Association (*Indian Textile Journal*, January issue). He pointed out that the companies could not exercise the ordinary right of terminating relations with an unsatisfactory customer. That being so they felt that in fairness to themselves and in the public interest they were not asking too much in seeking protection from unscrupulous, incompetent or dilatory local authorities. He added that it was regrettable that the Madras Government appeared determined to cripple or eliminate private enterprise in the supply industry, and this was symptomatic of the Government attitude in many parts of India. While not suggesting that public utility undertakings should not be strictly controlled, he considered that the idea of the State operating them should be opposed with every means at their disposal.

It was reported that during the year the Federation of Electricity Undertakings of India was incorporated as a limited company and Mr. Noel Paton was nominated to be a member of the Committee.

Circuit-Breakers

Restriking Voltage and Resistance Switching

SWITCHGEAR performance when breaking short-circuits is demonstrably dependent upon several factors which, together, are termed conditions of severity. A further such condition (which is acknowledged, but is not included in testing specifications) is the restriking voltage transient, its rate of rise being an important controlling attribute.

An endeavour to place this additional factor in its correct perspective by stating its effect on switch performance is made by MESSRS. J. A. HARLE and R. W. WILD (A. Reyrolle & Co., Ltd.) in a paper submitted to the Institution of Electrical Engineers. They believe that an international review of the standardisation of the air-blast breaker taking cognisance of the rate of rise is desirable, and they accordingly make proposals with the object of establishing a basis for standardisation and rating which will satisfy normal service requirements. The authors propose to rate the air-blast type in terms of breaking current, or MVA broken at a rated voltage and at a rate of rise of restriking voltage (R.R.R.V.). The latter would be stated as the maximum system severity that the breaker could deal with when rupturing a fault MVA equal to its rating, and for breakers without resistors would imply that a definite R.R.R.V./MVA characteristic approximating to a rectangular hyperbola existed.

Simplifying Selection

The authors describe how tests should be conducted in order to establish the validity of that characteristic, upon which they place reliance for selection according to their proposed method of rating. Adoption of their scheme, it is claimed, would make the selection of circuit-breakers relatively simple, especially for average substation service, which is typical of the majority of uses to which breakers are put.

Oil-immersed switches with plain breaks and arc-control contacts are relatively unaffected by the R.R.R.V., but in the case of air-blast types it is essential to take that factor into account. Therefore methods are proposed for specifying minimum rates of rise for each MVA rating and voltage, to enable an economic range of switchgear to be designed satisfying all average severity requirements in service and permit economic selection.

A simple method is outlined for checking the suitability of any breaker rated in the authors' way for normal service, together with data for checking the suitability for more unusual conditions. This method of selection involves calculating the fault MVA in the ordinary way and then ascertaining whether the proportion of the fault MVA contributed locally by the generators, transformers, and the like, is not in excess of an amount appropriate to the breaker's rating.

Resistance Switching

In another paper submitted at the same meeting MESSRS. H. E. COX and T. W. WILCOX (British Thomson-Houston Co., Ltd.) show how a switch must not only interrupt its rated breaking current, but should also limit the surge voltage which it causes while it is opening the circuit. The prospective value of over-voltage depends upon such circuit constants as inductance, capacitance and resistance as well as the rate at which the arc is de-ionised. It can often be dangerously high, actually being limited only by restriking within the breaker gap, which thus has to be proportioned for a dual purpose.

The breaking capacity and electric strength of an air-blast nozzle are interdependent, unless the restriking-voltage transient can also be controlled. It can be modified by means of resistance switching, the introduction of which enables the first two factors to be controlled individually and independently. In this way it confers some degree of freedom on the designer of air-blast circuit-breakers for high voltage. An experimental method of determining the electric strength of switch nozzles under air-flow conditions is illustrated in the paper, which includes a description of a 132-kV air-blast breaker designed in conformity with the authors' conclusions, with the results of full-scale tests.

By combining resistance switching with series multi-breaks the distribution and exact shape of the restriking transient across each break can be accurately controlled, which means that "unit testing" of such breakers is completely valid, thus greatly increasing the scope of existing test plant for proving high breaking capacity switches.

The paper concludes with suggestions for modifying BS. 116 type tests for oil switches, which are not entirely satisfactory for air-blast breakers.

Argentine Power Progress

ACCORDING to the *Revista Electrotechnica*, the official organ of the Argentine Association of Electrical Engineers, the sales of electric power during the first six months of 1943 by undertakings representing 95 per cent. of the country's total production amounted to 1,105 million kWh as compared with 1,045 million kWh in the corresponding half of 1942, an increase of 5·7 per cent.

Industry and Education

Opportunities Provided by the New Bill

THE 250th informal meeting of the Institution of Electrical Engineers was held on March 20th and the chairman, Mr. G. V. HARRAP, calling attention to the occasion, said that it was also the 25th anniversary of the inception of the Informal Meetings. Mr. F. Pooley, the opener of the original discussion, recalled that the meetings arose out of a suggestion by the late Mr. C. H. Wordingham, who was then president of the Institution.

Dr. P. Dunsheath, O.B.E., M.A., then opened a discussion on "Industry's Opportunity in Education." He said that the appearance of the Government's Education Bill made it necessary for industry in general and the engineering industry in particular to take stock of the position and consider the future relationship of industry and education. He emphasised that he was only dealing with part-time education which affected the class of young people who were not likely to occupy the higher posts in industry, and he was not considering university or technical college training. The new Education Bill, he said, would be a landmark, not only in education but also in the industrial life of the country.

In the general discussion which followed there was little dispute as to the object to be achieved. Such difference of opinion as there was—and this was the reflection of differing viewpoints—concerned the methods to be adopted. The point was stressed that unemployment after this war would be unlikely; a shortage of labour would be more probable. The withdrawal of highly-trained people to teach the younger ones might prove a strain on industry and tend to increase the cost of our products, for a time, in the markets of the world. This fact, it was suggested, might handicap some firms in carrying out such a programme as Dr. Dunsheath had envisaged.

Practical Training

The advantage of "learning by doing" was advocated as an alternative to sending boys to an educational establishment, inside or outside the works for craft training. On the more philosophical side the view was expressed that the future must be the age of the man, rather than that of the machine.

Some interesting details were given of works' part-time education schemes on both large and small scales, the object in one case particularly being to transform the "machine-minded" type into something more akin to the old-type skilled craftsman with interest and pride in his vocation.

There was general acceptance of the view that industry would have to change its outlook with regard to the cost of this form of education and treat it as an investment. One organisation was said to be spending £250,000 a year on the education of its employees at the present time, a course which had proved to be well worth while. The same speaker, however, contended that such education must be divorced from production. The importance of vocational selection and, where advisable, the changing of young people from one job to another was emphasised as a vital part of any educational scheme in industry.

In a brief summing up Dr. Dunsheath expressed his pleasure at the substantial degree of unanimity that evidently existed as to the importance of industry seizing the present opportunity to effect the far-reaching and beneficial educational changes which were latent in the terms of the new Education Bill.

Brighton Grid Charges

IN a report by the Brighton Corporation Committee it is stated that last June the Central Electricity Board gave notice to determine, on December 31st, the agreement for the supply of electricity by the Board to the Corporation. The Board contended that, consequent upon the general decrease of efficiency in the generating stations throughout the country, the terms of the original agreement in so far as the basic running charge of 0·15d. per kWh was concerned were no longer equitable. The Board offered a new agreement on the same general terms as the old one, but with a running cost based on the actual coal cost per kWh incurred at the generating station. Suitable safeguards would be included to protect the Corporation from the adverse effects of uneconomic loading of the station by the Board.

The Committee reports that for the financial year ended March 31st, 1943, the additional cost to the Corporation, had the proposed new tariff been in operation, would have been £11,200, making a total bill of £299,618. Although the new tariff would result in a larger charge than would have been payable under the agreement which terminated on December 31st last, it is still much less than what the Corporation would pay were it buying its energy at grid tariff (actually about £342,000). The proposed new tariff is also considerably less than the amount which the Board is willing to agree as the cost of independent operation. Protracted negotiations have taken place with the Board, but it has not been possible, under present conditions, to secure more favourable terms, and the Committee accordingly recommends that the new tariff shall be accepted and that an agreement be entered into for the period of four years.

COMMERCE and INDUSTRY

Electrical Machinery Standards. Higher Retail Wages.

Red Cross Appeal

WE have received from the organisers of the Electrical Industries Red Cross Appeal the nineteenth list of donations. The list is as follows:—B. S. & W. Whiteley, Ltd., £10 10s.; Lawrence G. Western, £5 14s. 6d.; Bristol Selectric Circle, £2 10s.; Electrical Engineers, Ltd., 13s. 6d. With amounts already acknowledged the total is £6,517 15s. 1d. In addition covenanted subscriptions have reached a total of £11,135 15s.

Standard Motors and Generators

The publication is announced of a standard war emergency specification for motors and generators, AC and DC, excluding ship-borne and airborne machines. It has been prepared by a Government Inter-departmental Committee to indicate the minimum requirements for machines of up to 300 kW capacity in order to afford relief to manufacturers.

The new document (BS. 1156) is based on BS. 168-1936, but additional classes have been inserted to cover essential requirements in respect of peculiar and arduous service conditions. The chief additions provide for a temperature "ceiling," more rigorous specification of insulation and impregnation, maximum departure from straight-line regulation in the case of compound-wound DC generators, and also over-speed tests. But some mitigation of former requirements has been provided and the standard test clause should therefore afford considerable relief to manufacturers. Copies of the new specification are obtainable from the British Standards Institution, 28, Victoria Street, London, S.W.1, price 1s. post free.

Retail Trade Wage Increase

The National Joint Industrial Council for the Retail Furnishing and Allied Trades, which covers the electrical and radio retail trades, has decided to increase the minimum weekly rates of remuneration by 4s. per week in the case of all male employees and 3s. per week in the case of all female employees. The new rates of remuneration come into operation on the first pay day after April 3rd.

Export Licences

The Export Licensing Department (Board of Trade) will shortly move from Inveresk House, 346, Strand, London, W.C.2, and Alexandra House, Kingsway, London, W.C.2, to 3, Bank Buildings, Princes Street, London, E.C.2, and Stafford House, King William Street, London, E.C.4. It is hoped that the move will be completed before Easter. In future all communications should be sent to 3, Bank Buildings, London, E.C.2 (Clerkenwell 4373). Persons wishing to interview any member of the staff are advised to ascertain in advance from Inveresk House (Temple Bar 1221, Ext. 6) at which premises they should attend.

Halifax Fuel Economy Campaign

The window display illustrated, sent to us by Mr. A. G. Connell, borough electrical engineer and manager of Halifax, forms part of his undertaking's campaign to bring home to the domestic consumers their increased consumption as compared with last year, and appealing to them to cut it down this year. In another window a scale model of a high-pressure boiler shows its consumption of coal and points out that coal supplies are definitely rationed. The notices are changed from day to day according to the rise and fall. One very good slogan in another window is "Electricity is your servant. Give it the morning off."

Effective window display urging fuel economy at Halifax

Damages for Widow

An award of £1,000 damages and costs was made against General Gas Appliances, Ltd., of Audenshaw, in the Civil Court at Manchester Assizes on March 16th. The action was brought by Mrs. Brenda Foulds, of Ashton-under-Lyne, for the loss of her husband, Harry Foulds (23), a sheet metal worker, who received a fatal electric shock at the premises of the defendant company. For the plaintiff it was stated that when the accident happened Mr. Foulds was using an electric drilling machine which, it was alleged, had no plug connection, bare wires being run from a

switchboard. For the defence it was contended that the accident was caused or contributed to by the negligence of the dead man. The company's production manager stated that a Denton firm looked after the electrical appliances and no employee had any authority to interfere with any electrical equipment or installation. The Judge, giving judgment, said the evidence had shown that Mr. Foulds was an obedient and disciplined workman.

Portable Vulcanisers

The Board of Trade has made the Machinery Plant and Appliances (Control) (No. 6) Order, 1944 (S.R. & O. 1944 No. 276). This Order, which came into operation on March 27th, amends the No. 3 Order with the effect that bench and portable vulcanisers (previously included in Class 68 of the schedule), of which the price to the customer in the open market on normal settlement terms is less than £25, are no longer subject to licence.

Home Trade Register Revised

The Home Trade Register kept by the Board of Trade for the purposes of the Limitation of Supplies (Miscellaneous) Orders has recently been revised, and copies are obtainable from the Stationery Office, price 1s. 6d. Registered persons should refer to a copy of this publication to ensure accurate computation of their quotas of controlled goods.

Contract Price Adjustment Formulæ

The British Electrical and Allied Manufacturers' Association informs us that the latest figures for use in its contract price adjustment formulæ are as follows :—(a) Rates of Pay—The rate of pay for adult male labour at March 18th shall be deemed to be 86s. 6d. (no change). (b) Costs of Material—The index figure for intermediate products last published by the Board of Trade on March 18th is 172·8 (no change) and is the figure for the month of February, 1944.

Transporting a Large Stator

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Flameproof Starters

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The commencement of our series of articles on "Engineers of the Future" has led Blackburn Aircraft, Ltd., Brough, E. Yorks., to send us a brochure describing the scheme in vogue at their works. Although this is not of an electrical character, being devoted entirely to aeronautical engineering, the general principles and operation of the scheme should be of interest to those electrical concerns who have, or contemplate, educational and training schemes of their own. The available courses are aircraft engineering (design and research), drawing office apprenticeship and production engineering apprenticeship. For these certain educational qualifications are called for. There is a trade apprenticeship, aiming at producing skilled craftsmen, for those without these qualifications. The brochure is well illustrated.

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year the demand for company's products decreased slightly owing to less re-armament requirements and also through the cautious policy in the construction of new hydro-electric power stations. On the other hand activity in the branch producing equipment for locomotives, trams and other means of transport remained lively. Export possibilities were further restricted because of the long pauses in the safe conduct traffic during certain periods of the year. At December 31st the company and its subsidiaries employed 21,962 persons compared with 21,113 a year earlier.—*Reuter's Trade Service.*

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Torch Bulb Inquiry

A firm of manufacturers' agents in Malta have asked us to put them into touch with British manufacturers of electric torch bulbs who are not already represented in the island. They state that they wish to place an order for 10,000 bulbs. We shall be glad to send further particulars to any interested manufacturer.

Fatalities

Light in Garden.—A verdict of "Death by misadventure" was returned by the Birmingham coroner at an inquest on Leonard H. Taylor (44). It was stated that he had received a fatal electric shock in his garden while working on a wiring extension made by his stepson to provide a light in a garden shed. The coroner remarked that, by taking advantage of the Birmingham Electric Supply Department's offer to give free advice on all matters relating to household electricity, the public could ensure that their electrical fittings were safe.

Repairs after Snowstorm. — A linesman, Thomas Gilbert C. Paling (39), employed by the Derby & Notts Electric Power Co., received a fatal shock on February 28th, the day after a heavy snowstorm, when he went with colleagues to attend to an overhead line at Cropwell. At the inquest it was stated that because the wires were plaited it was assumed that they were "dead." A verdict of "Accidental death" was recorded.

Information Wrapper

A diagram and instructions describing how to read electricity meters are printed on a new wrapper prepared by Thorn Electrical Industries, Ltd., for their "Atlas" lamps.

New Argentine Companies

Among new companies authorised by the Argentine Government are "Baterex," Soc. An., Industrial, Comercial y Financiera, with a capital of $100,000 c/l, for the purpose of manufacturing and dealing in electrical appliances and general merchandise, company financing, etc.; and Telefonica Neuquen y Rio Negro, Soc. An., Cia, with a capital of $1,000,000, to exploit the telephone system and installations of the Neuquen and Rio Negro telephone company.

Other new companies recently formed in Argentina include the following: — Emeta, Comercial e Industrial, Soc. de Resp. Ltda., capital $150,000 c/1, with the object of metallurgical and electro-technical production; and Casa Jaspe, Soc. de Resp. Ltda., capital $400,000 c/1, to deal in electrical appliances and material, etc.

Industrial Publicity

The reorganised Works Relations Centre was officially opened on Tuesday last by the Minister of Production. Its object is to indicate to works managements what kinds of material are available for use as factory publicity to aid production by stepping up output, improving quality, avoiding waste, reducing the accident rate and building up factory morale. The London Centre at Ivybridge House, Adelphi, Strand, is intended to serve the needs of the London, South Eastern, Eastern and Southern regions. It has been set up and is maintained by the Ministry of Supply under the control of the Industrial Publicity Committee, which is representative of a number of Ministries.

Electrode Boilers for Clydebank

Clydebank Town Council at its last meeting discussed the heating of the Municipal Buildings and Baths and decided in favour of electrode boilers if the Scottish Home Department does not refuse permission, in which event two boilers are to be hired as a temporary measure.

The Master of Works reported that he had been in communication with the Clyde Valley Electric Power Co., Ltd., which intimated it was prepared to provide a supply of electricity to the extent of 750 kW, with transformer equipment, provided the council undertook to consume or pay for £800 of electrical energy per annum. He also reported that Bastian & Allen, Ltd., advised him that they were prepared to hire to the Council two electric boilers for £300 per annum. These payments would be credited to the Council in the event of its deciding to install a complete electrical heating system after the war. The company undertook to complete the installation and have it working in six weeks from the date of the order, the Council to bear the cost of installation, estimated at £400.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

British made disc type thermostat with concave-convex snap action.

Refrigerated drinking fountain (British made).

TECTIC brass flux.

LACSIN cement.

switchboard. For the defence it was contended that the accident was caused or contributed to by the negligence of the dead man. The company's production manager stated that a Denton firm looked after the electrical appliances and no employee had any authority to interfere with any electrical equipment or installation. The Judge, giving judgment, said the evidence had shown that Mr. Foulds was an obedient and disciplined workman.

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Fatalities

Light in Garden.—A verdict of "Death by misadventure" was returned by the Birmingham coroner at an inquest on Leonard H. Taylor (44). It was stated that he had received a fatal electric shock in his garden while working on a wiring extension made by his stepson to provide a light in a garden shed. The coroner remarked that, by taking advantage of the Birmingham Electric Supply Department's offer to give free advice on all matters relating to household electricity, the public could ensure that their electrical fittings were safe.

Repairs after Snowstorm. — A linesman, Thomas Gilbert C. Paling (39), employed by the Derby & Notts Electric Power Co., received a fatal shock on February 28th, the day after a heavy snowstorm, when he went with colleagues to attend to an overhead line at Cropwell. At the inquest it was stated that because the wires were plaited it was assumed that they were "dead." A verdict of "Accidental death" was recorded.

Information Wrapper

A diagram and instructions describing how to read electricity meters are printed on a new wrapper prepared by Thorn Electrical Industries, Ltd., for their "Atlas" lamps.

New Argentine Companies

Among new companies authorised by the Argentine Government are "Baterex," Soc. An., Industrial, Comercial y Financiera, with a capital of $100,000 c/l, for the purpose of manufacturing and dealing in electrical appliances and general merchandise, company financing, etc.; and Telefonica Neuquen y Rio Negro, Soc. An., Cia, with a capital of $1,000,000, to exploit the telephone system and installations of the Neuquen and Rio Negro telephone company.

Other new companies recently formed in Argentina include the following: — Emeta, Comercial e Industrial, Soc. de Resp. I.tda., capital $150,000 c/1, with the object of metallurgical and electro-technical production; and Casa Jaspe, Soc. de Resp. Ltda., capital $400,000 c/1, to deal in electrical appliances and material, etc.

Industrial Publicity

The reorganised Works Relations Centre was officially opened on Tuesday last by the Minister of Production. Its object is to indicate to works managements what kinds of material are available for use as factory publicity to aid production by stepping up output, improving quality, avoiding waste, reducing the accident rate and building up factory morale. The London Centre at Ivybridge House, Adelphi, Strand, is intended to serve the needs of the London, South Eastern, Eastern and Southern regions. It has been set up and is maintained by the Ministry of Supply under the control of the Industrial Publicity Committee, which is representative of a number of Ministries.

Electrode Boilers for Clydebank

Clydebank Town Council at its last meeting discussed the heating of the Municipal Buildings and Baths and decided in favour of electrode boilers if the Scottish Home Department does not refuse permission, in which event two boilers are to be hired as a temporary measure.

The Master of Works reported that he had been in communication with the Clyde Valley Electric Power Co., Ltd., which intimated it was prepared to provide a supply of electricity to the extent of 750 kW, with transformer equipment, provided the council undertook to consume or pay for £800 of electrical energy per annum. He also reported that Bastian & Allen, Ltd., advised him that they were prepared to hire to the Council two electric boilers for £300 per annum. These payments would be credited to the Council in the event of its deciding to install a complete electrical heating system after the war. The company undertook to complete the installation and have it working in six weeks from the date of the order, the Council to bear the cost of installation, estimated at £400.

INFORMATION DEPARTMENT

GENERAL inquiries from readers relating to sources of electrical goods, makers' addresses, etc., are replied to by our Information Department through the post. Inquiries should be accompanied by a stamped addressed envelope.

Our extensive records enable us to reply to most queries, but occasionally we ask for our readers' assistance in tracing names and addresses not known to us. We should be glad to have such information regarding the makers of the following:—

British made disc type thermostat with concave-convex snap action.

Refrigerated drinking fountain (British made).

TECTIC brass flux.

LACSIN cement.

Portuguese Imports

Increased Electrical Purchases in 1942

THE Portuguese authorities have published returns of the foreign trade of the country for 1942. The accompanying table shows the value in that year of the principal electrical imports, by countries of origin, with a note of increase or decrease compared with 1941. The plaints about the increased cost of living which may be attributed largely to the restrictive effect which the war has exercised on the country's trade. Public works schemes connected with the attraction of tourists include power plants and river improvements to cost £500,000. The

Class	1942 Escudos (000)	Inc. or dec.
Accumulators and condensers weighing less than 8 kg. per cell—	1,325	− 534
From Germany	309	+ 185
„ United States	253	− 872
„ United Kingdom	459	− 22
„ Switzerland	141	+ 135
Other elec. accumulators, condensers and parts—	1,161	− 582
From Germany	97	+ 84
„ United States	179	− 133
„ United Kingdom	216	− 6
Loudspeakers—	176	− 246
From United States	84	− 251
„ United Kingdom	60	+ 15
Radio apparatus—	11,941	+ 112
From Germany	4,953	+ 3,996
„ United States	1,319	− 8,294
„ United Kingdom	2,839	+ 2,127
„ Switzerland	527	+ 409
Telephone apparatus—	2,779	+ 944
From Germany	319	+ 168
„ United Kingdom	804	+ 335
„ Sweden	1,636	+ 494
Generators, motors, transformers and parts weighing up to 100 kg.—	7,755	+ 2,089
From Germany	3,094	+ 1,503
„ United States	431	− 1,066
„ United Kingdom	803	− 323
„ Switzerland	2,488	+ 1,656
„ Sweden	762	+ 357
Ditto, weighing 100 to 500 kg.—	3,647	+ 520
From Germany	1,051	+ 750
„ United States	49	− 468
„ United Kingdom	342	− 19
„ Switzerland	1,711	+ 604
„ Sweden	442	+ 442
Complete installations for telephone exchanges (not including telephones, accumulators or dynamos)—	3,477	+ 2,299
From United Kingdom	106	− 186
„ Sweden	986	+ 155
„ Germany	2,255	+ 2,201
Insulators, not porcelain—	10	+ 1
From United Kingdom	7	− 2
„ United States	3	+ 3
Insulating materials and porcelain insulators—	3,161	− 435
From Germany	1,779	− 480
„ United States	195	− 353
„ United Kingdom	496	+ 114
„ Sweden	527	+ 447
Batteries, dry—	522	+ 38
From United States	73	− 60
„ United Kingdom	159	+ 7
„ Germany	211	+ 39
„ Sweden	75	+ 75
Batteries, other—	48	+ 20
From United Kingdom	22	− 4
Vacuum cleaners—	1,298	+ 222
From Germany	127	− 61
„ Sweden	1,152	+ 353
Insulated wire or cable, textile-covered, weighing up to 120 grammes per metre—	2,280	+ 1,610
From United Kingdom	605	+ 161
„ Sweden	518	+ 511
„ Spain	641	+ 639
„ Germany	412	+ 320
Ditto, weighing over 120 grammes per metre—	867	− 968
From Germany	9	− 576
„ United Kingdom	853	− 283
Ditto, with asbestos, and metal-protected—	1,762	− 6,022
From United Kingdom	804	− 5,851
„ United States	447	+ 103
„ Germany	447	+ 291
Ditto, with rubber—	593	− 831
From United States	91	− 1,129
„ United Kingdom	472	+ 297
Lamps, for lighting or heating—	13,287	+ 4,218
From Germany	5,722	+ 3,597
„ United Kingdom	2,092	+ 493
„ Hungary	4,643	+ 3,341
Lamps, other electric—	4,262	+ 945
From Germany	1,289	+ 462
„ United States	578	− 1,080
„ United Kingdom	502	+ 149
„ Hungary	1,468	+ 1,265

trade as a whole expanded in spite of difficulties of obtaining goods from the chief supplying sources. Outstanding increases took place in the imports of telephone installations and material, lamps, and power plant, while decreases occurred in accumulators and condensers and in most kinds of cable. In only a few lines was the share of the United Kingdom maintained. American participation also declined, while that of Germany, Sweden and Switzerland was more prominent.

The national finances of Portugal remain healthy. For 1944 the budget shows a net surplus of 900 contos—rather more than in 1943. There are strong and widespread com- work is planned for completion this year. (The exchange rate for escudos is about 100 to the £.)

Swedish Electrified Lines—The electrification of two more railway lines, from the Hälsingborg to Hässleholm and the Ramlösa to Eslöv (about 122 kilometres) has recently been completed. Thus an electrified local triangle has been created which is connected with two trunk-lines, also electrified. In a recent speech, the Minister of Communications, Mr. Andersson emphasised the great value of these extensive electrification schemes to Sweden.—*Reuter's Trade Service.*

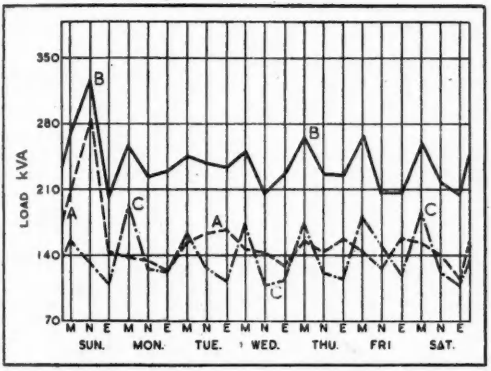
Domestic Load

Characteristics Underlying Tariff Uniformity

By F. J. Elliott, M.I.E.E.

IN his paper "General Factors affecting the Unification of Electricity Supply Tariffs"[1] Mr. C. T. Melling stated that "as a preliminary to formulating a uniform system of tariffs there should be an expert examination of the various electrical, economical, industrial, sociological and competitive factors affecting undertakings," and Mr. P. Schiller in a sister paper "Towards the Correct Domestic Multi-Part Tariff"[2] suggested the installation of special distribution systems in selected areas in representative parts of the country to enable continuous records to be obtained over a series of years. Actually much valuable information is readily obtainable in most undertakings with little expenditure of time or money.

An article by Mr. E. E. Jolly on "Diversity Factor," published in the *Electrical Review* of September 10th, 1943, contains much useful information as to the characteristics of the domestic load in a metropolitan borough with a very high consumer density, approaching twenty-four per acre for the whole borough and more than double that density for the block of flats dealt with in which the income level of the residents varies little as between one and another.



Comparative load curves of three housing estates. A, municipal estate. B, private estate with £500-£700 houses. C, private estate with £2,000-£3,000 houses

For some time past I have been collecting data of a similar character in a county borough with a consumer density less than half that of Bethnal Green. Three estates were selected with average rateable values of £10, £20 and £40 per annum, and presumably a corresponding variation in the income level of the consumers.

The estates vary in extent from 50 to 100 acres, and the number of consumers from just over 100 to nearly 800. The estates possess one feature in common, namely, supply is afforded to the whole estate from a single substation established and equipped at a similar overall cost.

The load indicated by the accompanying graph of each of the estates was taken during the week when the undertaking peak occurred. The Sunday mid-day peak is noticeable in the case of estates A and B, and the daily morning peak in the case of C. The latter feature is undoubtedly due to the greater use made of space heating, as is evidenced by the winter consumption exceeding the summer consumption by 162 per cent., resulting in an estate load factor for the year of only 16·8 per cent. (lines 10 and 11 in the table). From further information kindly supplied me by Mr. Jolly the comparison can be extended to the conditions obtaining in a London metropolitan borough, as shown in the table.

Dealing first with the degree of development obtainable in varying types of residential areas, the connected load, consumption and revenue per consumer reach highest values in the Bethnal Green flats, where the income level of the consumers is round about one-fifth of those in estate C, indicating that a high degree of development is obtainable amongst consumers on the lower income level if facilities for using electricity are provided without involving the consumer in capital expenditure—a fact which emphasises the need for salesmanship at the planning stage of housing development. In this direction E.D.A. is to be commended upon the evidence submitted to the Ministry of Health through the Sub-Committee on the "Design of Houses and Flats."

A large part of the controversy upon the cost of supply to domestic consumers centres round the maximum demand of this load. Since the cost of supplying a given m.d. to a given area is unaffected by the number of

[1] *I.E.E. Journal*, Volume 90, Part I, No. 32, August, 1943, p. 320 (5.2.2.)
[2] *Ibid.*, p. 335 (17).

premises supplied in that area, it follows that when considering the maximum demand of groups of consumers due regard must be paid to consumer density. This fact is exemplified in the table, where there is very little difference in the maximum demand per acre in each of the estates (3·0, 3·15, 3·38 kVA) in spite of the m.d. per consumer being over seven times greater in estate C than in A. This feature has the effect of levelling the maximum demand costs between one class of estate and another. It would be of interest to know if a similar levelling effect obtains in the case of blocks of flats with corresponding differences in the rateable value and consumer density.

	A	B	C	BETHNAL GREEN
1. Average rateable value, £	10	20	40	13–13
2. Consumers on two-part tariff, per cent.	25	57	95	100
3. Consumer density, per acre	13·5	6·5	2·5	50
4. Connected load per consumer, kW	2·45	4·09	9·0	12·7
5. A.D.M.D. per consumer, kVA	0·22	0·49	1·69	1·616
6. Maximum demand per acre, kVA	3·0	3·15	3·38	80
7. Capital cost of distributors and services per acre, £	133	89	56	625
8. Capital cost of distributors and services per consumer, £	9 16s. 3d.	13 14s. 10d.	28 8s. 0d.	12 10s. 0d.
9. Annual consumption per consumer, kWh	652	588	2,491	2,883
10. Increased consumption—winter over summer, per cent.	32	70	162	39
11. Estate load factor, per cent.	23·6	22·9	16·8	20·36
12. Tariffs:				
Fixed charge per annum, £	1 12s. 0d.	2 12s. 0d.	4 0s. 0d.	1 6s. 0d.
kWh charge, d.	0·5	0·5	0·5	0·666
13. Revenue				
Average per consumer, £	2 19s. 2d.	3 14s. 6d.	9 2s. 9d.	9 6s. 2d.
Average per kWh, d.	1·09	1·52	0·88	0·77
14. Revenue per £100 of capital expenditure, £	30 1s. 10d.	27 2s. 7d.	40 4s. 6d.	74 9s. 4d.

Gathering Information

Capital costs rank next in importance to the cost of energy and vary widely throughout the supply industry, and therefore offer the most profitable field for investigation.

The compilation and circulation amongst distribution authorities of data similar to that here presented by representative undertakings up and down the country would undoubtedly result in undertakings with the lower costs being used as a "target" by those with the higher.

Many electrically equipped housing estates and blocks of flats in various parts of the country have been in existence for a number of years, and an investigation carried out somewhat on the lines of the Gallup Poll should provide sufficient information to enable the industry to assess the relative importance of such factors as maximum demand, capital charges, load factor and consumption per consumer at their true value, and thus arrive at a simplified form of tariff.

A pre-requisite for the institution of such an investigation would be the formation of some body to carry it out, and too much emphasis cannot be given to the hope expressed by Lieut.-Col. E. H. E. Woodward at an I.E.E. discussion[3], "that such committees as are formed will consist mainly of those who are actually in the electricity supply business and who are in constant contact with large numbers of consumers, and do not have to draw their conclusions as to the consumer's outlook from second-hand information."

(3) *I.E.E. Journal*, August, 1943, p. 350.

Industrial Films

A MEETING was held on March 24th in the canteen of the Midland Electrical Manufacturing Co., Ltd., Tyseley, Birmingham, after the first Ministry of Information film "Trade Show" had been presented. Mr. W. J. Barber, who opened the show, said the idea had originated because he had walked out of the last show at the works. The audience were representatives of an important group of Birmingham factories who pointedly expressed their opinions about the seven films shown and about factory films in general.

A principal objection was that the films were badly constructed in that they did not tell a connected story, and were apt to give a series of unrelated shots. Light, humorous touches, it was suggested, should be introduced into the films, which were to be shown during the lunch-hour break, or at the end of a day's work. It was asserted that films were being made about the things which the workers knew all about and wanted to forget—the factories in which they spent so much time. Bad sound production was one complaint, and another was that there was too much blatant propaganda and too many amateur actors. A series of documentary films about the Empire was asked for.

Mr. Russell Ferguson, Midland Regional Information Officer, welcomed the last suggestion, and said that the idea was being worked on. He explained that poor sound reproduction was due to scarcity of film material, for films had to be shown many more times than was desirable before they were scrapped. The "scrappiness", he continued, was part of a general technique for documentary films, which was being superseded.

ELECTRICITY SUPPLY

Cooker Demand at Hull. Lessening London's Smoke.

Belfast.—UNIFORM CHARGES.—The Electricity Committee has decided that tariffs shall be uniform inside the city and in the outer area. Accordingly it is reducing the charges to consumers outside the city boundary as from April 1st. The lighting flat rate, for example, is to be 6d. instead of 6½d. per kWh.

Duffield (Derbyshire).—ELECTRIC STREET LIGHTING.—When street lighting is resumed it will be all-electric instead of partly by electricity and partly by gas as before the war. A system of "starlighting" is to be introduced next September.

Dundee.—ELECTRICITY FOR MENTAL HOSPITAL.—In September last the Town Council considered a recommendation by the Hospitals Sub-Committee that electricity for the Mental Hospital at Westgreen should be taken from the Grampian Company in place of the present supply from private plant belonging to the hospital. An amendment was then carried that there should be a report on the possibilities of the production of electricity from steam plant at Westgreen, Treasurer Caldwell contending that they could produce electricity at a much lower rate than the Grampian Co. charged. The matter again came before the Public Health Committee at its last meeting when supporters of Grampian supply argued that AC was favoured by doctors and those engaged in X-ray work, and that if the Committee were to generate the power it would require new engines and new boilers. An amendment to appoint a consultant to advise the Committee was carried.

Hull.—DEMAND FOR COOKERS.—Mr. D. Bellamy, general manager of the Electricity Department, reported to the Electricity Committee recently that electric cookers continued to be in demand. He said that this was due to the reconditioning of houses and the return of people. The cookers were in hand and available for installation.

London.—SMOKE ABATEMENT.—Reference is made in the County of London Plan to the unsatisfactory conditions caused by the smoke from domestic, industrial and commercial buildings and from steam locomotives. The St. Pancras Post-War Planning and Co-ordinating Committee, which has been considering the Plan, expresses its conviction that smoke polluted atmosphere is a danger to health and damages property, and recommends that all possible steps should be taken to prevent the nuisance. Favourable consideration, it suggests, should be given to smokeless heating arrangements for all buildings and in this connection it mentions the possibility of district heating in conjunction with the waste heat from electricity generating stations.

Mansfield.—LOAN.—The Electricity Committee has obtained sanction to borrow £1,000 for mains and services.

Norwich.—COLOUR OF STREET LIGHTING.—Mr. J. A. Sumner, city electrical engineer, speaking at a local luncheon, outlined the present trend of research in lighting and heating problems. In Norwich, he said, experiments were being carried out to discover whether the colour of the street lighting could be changed to one that the citizens would appreciate more.

Peterborough. — SCHOOL LIGHTING. — The Education Committee is making application for the installation of electric lighting in Thornhaugh Council School.

Salford.—OPERATION OF COAL CLAUSE.—Last year the Light, Heat and Power Committee submitted to the Electricity Commissioners a proposal for the variation of electric power charges (including traction) according to the cost of fuel. It is now announced that a coal clause will come into operation as from April 1st. The basic coal cost figure is 31s. 6d. per ton and the variation will be 0·001d. per kWh for each 1d. per ton increase or decrease.

Walthamstow.—SUSPENSION OF MINIMUM CHARGE.—The Electricity Committee has recommended that the minimum charge shall be suspended.

Overseas

Australia. — SUPPLY IN THE SOUTH. — Last year a Government Committee was set up to consider questions relating to electricity supply in South Australia and its final report was presented to the State Parliament last November. Commenting on the Committee's findings at the annual general meeting of the Adelaide Electric Supply Co., Ltd., Mr. J. S. Murray (chairman) said that the Premier had given as the primary reason for the Committee's appointment his alarm at the condition of electricity supply in the State. However, it seemed that the inquiry had developed into an investigation into the use of Leigh Creek coal.

In the course of its proceedings the Committee asked the company to indicate the manner in which it would be prepared to assist in promoting the use of Leigh Creek coal. The company offered to make certain alterations to its plant so as to use this fuel in conjunction with New South Wales coal and to consider the exclusive use of Leigh Creek coal in pulverised form in the second section of Osborne "B" in the light of the experience gained in the first section. The introduction of pulverised fuel would, however, necessitate drastic and costly alteration to the design of the boilers, and the company had been advised by the manufacturers, Babcock & Wilcox, Ltd., that they were not at present in a position to prepare these designs in the absence of sufficient experience with Leigh Creek coal. In making the offer the company stressed that, in its opinion, the use of Leigh coal would prove to be entirely uneconomic, and this view was amply borne out by the Committee's own findings, according to which the annual accrued losses in the first nine years would for one scheme amount to over £1,000,000, and for an alternative scheme to over £2,000,000.

The Committee further proposed that a co-ordinating authority should be appointed by the State, and on this subject Mr. Murray said that

the company was strongly opposed to the creation of such a body. The question arose whether it was not just a means of enforcing the use of Leigh Creek coal on the company at a price which ensured that the inevitable losses would fall upon the company and not on the State.

The 1942-43 report of the Adelaide Company records an increase in net revenue from £488,911 to £499,735. Total kWh sold rose from 224 million to 241 million and the number of consumers from 110,078 to 111,593. Considerable progress has been made in the construction of the new Osborne "B" power-house and the company is endeavouring to obtain from the authorities in England approval for the manufacture of a third boiler and second turbo-alternator.

Canada.—OUTPUT IN 1943. — A new high record in monthly output was set by central electric stations during December when 3,560 million kWh was produced, compared with 3,252 million kWh in the corresponding month of 1942, the Dominion Bureau of Statistics reports. Production for 1943 was 40,378 million kWh as compared with 37,199 million in 1942, an increase of 8·5 per cent. over 1942 and 42·4 per cent. over 1939. The largest increase during the year was in Quebec where production rose from 20,753 million to 23,462 million kWh. Consumption of primary power increased by 9·9 per cent. to 35,719 million kWh. Exports to the United States amounted to 2,545 million kWh as compared with 2,454 million in 1942.

New Zealand.—GENERATION STATISTICS.—Figures published in the *New Zealand Electrical Journal* show that during the year ended March 31st, 1943, the total amount of electricity generated was 2,036 million kWh, equal to 1,242 kWh per head of the population. The output represents an advance of 5·6 per cent. on the previous year (1,929 million kWh), when the average per head was 1,183 kWh. The total plant capacity was raised from 522,759 to 534,231 kVA (main plant 419,898 kVA).

COBB RIVER SCHEME.—The Minister of Works announced recently that it was hoped to have the Cobb River hydro-electric scheme in operation by the end of May. The dam was not yet constructed, he said, but sufficient power could be generated with a normal flow of water because of the fall of 1,900 ft. The plant (9,300 kW) would be sufficient to supply Nelson and Marlborough with power for 12 or 14 years.

South Africa.—REDUCED DISCOUNT.—Durban City Council has decided to reduce the discount for payment of electricity accounts within thirty days from 10 to 5 per cent. About 80 per cent. of the consumers pay their accounts within the time allowed, but, strangely enough, a few years ago when the time limit was only seven days the proportion was higher—87½ per cent.

United States.—POWER SUPPLY IN 1943.—Estimates of power production by public utilities in 1943, published in the January *Edison Electric Institute Bulletin*, show that the rate of expansion was approximately 17 per cent. as compared with 12 per cent. in the previous year. The principal statistics are given in the accompanying table. In addition, it is estimated that 50,000 million kWh was generated by industrial plants for their own requirements, making a total output for all purposes of 271,000 million kWh. The combined electrical output of America and Canada (312,000 million kWh) is stated to be equal to half the total world production. The *Bulletin* says it seems likely that America's gigantic industrial war effort has reached its climax and that the demand for electric power will be stabilised at about the present level. The installation of new generating plant is therefore expected to decrease; for the present year 1,250,000 kW is scheduled, compared with 3,041,664 kW added during 1943.

STATISTICS OF AMERICAN UTILITIES

	1942	1943 (est.)
Plant capacity:	kW	kW
Steam	32,332,239	34,265,000
Hydro	13,025,320	14,112,100
I.c. engine	1,049,177	1,065,300
Total	46,406,736	49,442,400
Electricity generated:	Million kWh	Million kWh
Steam	123,356	144,770
Hydro	64,179	74,400
I.c. engine	1,646	1,830
Total	189,181	221,000
Net imports	1,448	1,540
Sales to consumers:		
Residential	26,937	28,775
Rural	2,890	2,875
Commercial	115,612	135,150
Railways	6,628	7,250
Public authorities ..	7,341	11,950
Total	159,408	186,000
Number of consumers ..	26,620,456	26,817,700

TRANSPORT

Bournemouth.—S.R. ELECTRIFICATION POLICY.—When Mr. C. Grasemann, public relations officer, Southern Railway, addressed a meeting in the town recently he was asked whether there was a possibility of the railway being electrified to Bournemouth after the war. He replied that a keen eye was being kept on extending electrification beyond its present limits and obviously Bournemouth and Southampton came into the picture, One difficulty was the long stretch through the New Forest, and another consideration was what the price of electricity would be in the future.

Darlington.—TROLLEY-BUS EXTENSIONS.—The Town Council is to apply for an extension of time allowed under the Darlington Trolley Vehicles (Additional Routes) Order, 1936, for the introduction of trolley-buses on three additional routes. The time limit expires on June 18th this year.

Fort William.—PROPOSED MOUNTAIN RAILWAY.—The Town Council at its last meeting appointed a special committee to consider ways and means of furthering the proposal for the construction of an electric railway to the summit of Ben Nevis, which is 4,406 ft. high.

RADIO

Great Britain.—RADIO RELAY STATISTICS.—At September 30th, 1943, there were 473,280 subscribers to 275 radio relay exchanges, compared with 455,588 subscribers to 276 exchanges at June 30th, 1943, an increase of 17,692 subscribers.

Flameproof Switchgear

New G.E.C. Unit

A NEW type of flameproof oil-immersed switchgear has been produced by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, for both high and low voltages, of a design that is intended to avoid exposure of live metal to atmosphere. The apparatus is certified at Buxton (Groups I and II) and has a proved breaking capacity of 25 MVA at 3·3 kV in accordance with B.S.116, and 10 MVA at 400 V in accordance with B.S. 936.

The unit consists of two portions, a bus-bar pillar and a withdrawable circuit-breaker, which are connected by plug and socket contacts. The cast-iron pillar is ribbed to withstand high internal pressures, and is mounted on steel rails which can be grouted to the floor. It has wide machined flanges, and fixing studs are shrouded where necessary in accordance with the Mining Regulations for flameproof equipment. The pillar is divided into two portions by means of a horizontal partition, the lower half containing the bus-bars and a combined bus-bar isolator and earthing switch, while the upper half contains the core balance current transformer and a line isolator (if required). The bus-bars are air-insulated copper strips, on edge horizontally, supported by porcelain insulators carried in removable housings.

Isolation and Earthing

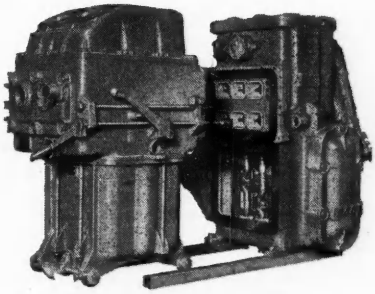
Three vertical copper rods in front of the bus-bars, supported on porcelain insulators, carry current from the bus-bars to the lower set of fixed socket contacts. For isolation and earthing, the rods are rotated through 90 deg. by an external handle. This action disengages the pair of finger contacts on each rod from the corresponding blade on each bus-bar and brings them into the plane of the rods. In that position the fingers of the left-hand rod engage with an earth contact blade on the casing, while the fingers on the middle rod engage with a contact on the left hand rod, and those on the right-hand rod with a contact blade on the middle rod. All three phases are thus connected together and to earth.

The upper portion of the bus-bar pillar contains the core balance transformer for earth-leakage protection. When a breaker is required to control an incoming supply a line isolator is fitted in the upper chamber and the operating mechanisms of the bus-bar and line isolators are coupled together for simultaneous operation by a common handle, the line isolator serving to disconnect the upper fixed plug contacts from the cable. However, if it is desired to earth an interconnecting cable then the line isolator can be uncoupled to enable the bus-bar isolator to be operated independently. An external indicator, positively operated by direct contact, shows when the isolator is open. A detachable sealing box for connecting a cable directly to the bus-bars may be fitted to either side of the pillar. Plug contacts for the auxiliary circuits are fitted on the front of the pillar as required.

The triple-pole circuit-breaker has two breaks per phase and is connected to the bus-bars through fingers engaging with plugs in the pillar. Self-filling oil dash pots absorb shock on opening the moving contacts and, since buffer springs are also fitted, the breaker may safely be operated during inspection of contacts. The oil tank is a massive casting with plywood lining and barriers for phase separation; there are four wheels for easy withdrawal.

The breaker cover is of box form and contains the connections from the fixed contacts to the self-aligning withdrawable contact fingers mounted at the rear. It may also accommodate overcurrent trips, earth-leakage trip, ammeter, voltmeter, a shunt trip with (for high voltages) a potential transformer and fuses. Armour-plate glass windows are provided through which the meters can be read and visual indication given of the operation of the earth-leakage trip.

At the front are a push button for tripping the breaker and a knob for re-setting the earth-leakage trip and for restraining the trip mechanism when the switch is used to earth an outgoing feed cable. The knob may be locked



Breaker withdrawn from bus-bars beyond normal isolating position

so as to hold the breaker in the closed position. On the right-hand side are the interlocked operating handles, one for closing the breaker and the other for actuating the combined isolating and earthing switch inside the breaker chamber. Interlocking is very complete.

For easy inspection, the breaker having been withdrawn from the bars and the switch case hood removed, a lifting device consisting of three chain driven screws is inserted for raising the top cover by turning one handle, thus exposing the contacts for replacement.

This type of breaker can be used singly, or built up into switchboards, and can be removed from, or replaced, anywhere in the board without removing adjacent pillars. All cable boxes are detachable and may be jointed and compounded away from the switchgear. A lighting transformer up to 500 VA capacity, constructed as a self-contained unit, can be fitted anywhere in the bus-bar run.

FINANCIAL SECTION

Company News. Stock Exchange Activities.

Reports and Dividends

The County of London Electric Supply Co., Ltd.—Once again the company has not only maintained its progress but has improved upon it. Commenting on the satisfactory position, Sir Robert Renwick, chairman, stated at the annual general meeting on March 21st that the company's reserves had been fully maintained and subsidiary and associated companies showed on the whole similar progress and good results. Output had been more than satisfactory despite restrictions on the domestic and commercial market.

Unfortunately, he said, politics were making the task of post-war planning a difficult one and it was doubtful whether, for this one reason alone, the two sides of the industry, municipalities and private enterprise, would be able to put forward useful and concrete proposals. Immediately after the war there would be an unprecedented demand for electricity which they must be prepared to meet. He did not fear any great loss in the power supplies which the war had placed upon them; in fact during the war large new demands had cropped up which would continue and the use of electric power had permeated the factories of this country as never before.

Some apparently confused thinking about the degree of expansion had arisen from the fact that a statement had been made in Parliament that capital expenditure of public utility companies after the war would in some ways be controlled; in fact, it had been said that capital expenditure might have to be deferred so as to provide employment at any time that a slump period might occur. This might be a correct policy in regard to certain public works, but he was convinced that it could not be the correct policy to apply to electrification, because greater electrification was a first-class priority for reconstruction. The demand envisaged and the ability of the company to meet it might receive a serious setback if their business became too much controlled or bureaucratised.

This year marked the fiftieth year of the company's operations and to-day they served nearly 400,000 consumers over an area of 1,000 square miles, or nearly 3,000 if the areas of their subsidiary and associated companies were included.

The Metropolitan Electric Supply Co., Ltd.—Speaking at the annual meeting on March 21st, Major H. Richardson, chairman and managing director, said that there were undoubtedly some vital improvements which could be made after the war, to the great advantage of the country and its industries, if the Government, having enacted certain principles, took care to prevent the accession of any form of bureaucratic control. Control of this kind, although admirably fitted to the normal and meticulous duties for which it had been created and developed, could not by its very nature avoid crippling and obstructing initiative, enterprise, invention and the driving energy which would be required more than ever after the war.

The adoption of the McGowan Committee's Report, amended as suggested by the Incorporated Association of Electric Power Companies, would, he considered, establish the conditions necessary for the cheapest possible supply with the highest service and availability. Such a scheme would also have the advantage of preserving the essential spirit of initiative and proper competition between desirably large areas, some of which would be under local authority control and some under the control of public companies.

With regard to the London & Home Counties Joint Electricity Authority's scheme Major Richardson declared that the results achieved by the Authority were far from impressive and he submitted that it was not to a body operating under such an unwieldly constitution and so affected by political bias that one could look for advice or example in the control of an industry intimately bound up in the industrial and domestic life of the country. A great deal of progress had been and was being made in the development of electricity supply to rural areas and nearly all this had been carried out by undertakings controlled by companies.

North-Eastern Electric Supply Co., Ltd.—Mr. R. P. Sloan, C.B.E., presided at the annual meeting of the company on March 22nd and, in common with other chairmen of electricity supply companies, commented on the plans put forward for the reorganisation of the industry. He said that it was unfortunate that there should be such a wide diversity of views within the industry itself as this might well create the impression that it was failing lamentably in its service to the public—which, of course, was not the case.

As long ago as 1926 the then Parliamentary Secretary to the Ministry of Transport described the company as a model which he would like to see the whole of England follow. They felt that their organisation was of the type and covered the size of area which could be economically operated to the advantage of all concerned. For many years they had concentrated on the co-ordination and development of the distribution of electricity and had met with a considerable measure of success, but they realised that there remained room for improvement both there and elsewhere. In their area there were a number of independent distributing authorities; the best solution could be given to the problem if their areas came under one control. But there were formidable difficulties in the way of bringing about such consolidation.

Nevertheless, said Mr. Sloan, these difficulties must be faced and they might be overcome in the best interests of consumers by a scheme which would associate with the control representatives of all the local interests concerned. He concluded by asserting that the company had not signified agreement with any of the schemes so far submitted to the Government.

Lancashire Electric Light & Power Co., Ltd.—At the company's annual meeting on March 23rd, the chairman (Sir Joseph Nall, D.S.O., M.P.), referred to the reorganisation proposals which had been made. He maintained that there was no reason for creating an upheaval in the industry although there might be room for minor

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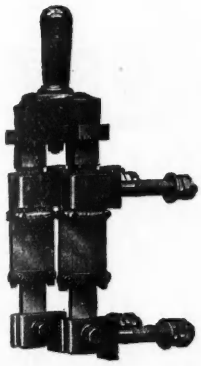

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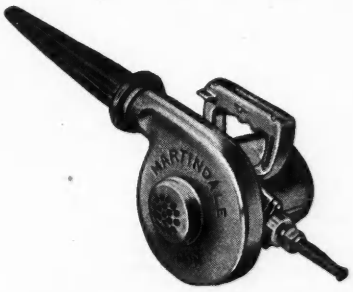

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adjustment and a desirability of achieving a more uniform basis for domestic tariffs. Describing the company as a good average example of a power company, he showed how the electricity supply in its area had been built up on progressive lines and claimed that now there were only three parishes in the area for which a public supply had not been fully authorised, although in two of these part supplies were given by the company or other authorities. There was evidence that public authorities in the area were satisfied with the company's service and Sir Joseph maintained that the only backwardness shown had been that caused by the war.

Other power companies had similar records. It was true that here and there some rural parishes were still awaiting a supply but these could be dealt with on their merits without putting the whole industry into a controversial turmoil and transfer of ownership which would probably hold up development for a year or two. People should realise that a change from company ownership to public boards or another form of nationalised monopoly meant that the shareholder who took his speculative chance of a dividend would merely become a rentier in receipt of guaranteed fixed interest which would be paid to him whether the business earned it or not: if it did not the payment would become a charge on public funds.

The Scottish Power Co., reports that the trading profits for 1943 of the undertakings which it owns and operates amounted to £1,082,102, as compared with £1,032,675 in 1942. After providing £546,593 (£421,040) for taxation, there was a net balance of £535,509, from which £202,465 (£258,896) has been appropriated for depreciation, renewals and reserves, or carried forward by those undertakings, the balance of £333,043 being the revenue, less tax, available to the holding company. Restoring the £293,043 income tax deducted, the gross revenue amounts to £626,087. The holding company's revenue, including miscellaneous receipts and £13,499 brought in, totalled £603,753. Taxation takes £315,753, contingencies £25,000 (£22,250 to general reserve), dividends on preference shares £96,000 (same) and dividends on ordinary shares £152,000 (same). The final dividend on the ordinary shares is 5 per cent. (5½ per cent.), again making 8 per cent., and £14,999 is carried forward.

The Lancashire United Transport & Power Co., Ltd., reports receipts for 1943 amounting to £675,450, as against £698,720. After providing for expenses, fees, income tax, pensions and grants to employees in the forces, the profit was £185,867 (£208,786), from which have to be paid debenture interest, tax provision £90,000 (£114,279), depreciation £35,000 (£26,000) and dividends including a final ordinary dividend of 6 per cent., making 10 per cent. (same). A sum of £1,669 (£1,514) is transferred to reserve. In 1942, £9,522 was provided for deferred repairs. It is proposed to convert the shares into stock.

S. Guiterman & Co., Ltd., report a net profit of £25,370 for 1943, as compared with £38,101 for the previous year. To this is added £11,921 (£11,820) brought in. Reserve for taxation takes £13,500 (£28,000), general reserve £2,000 (£2,500), special war contingency reserve £1,000 (£2,000) and employees' fund £500 (nil). The ordinary dividend is maintained at 10 per cent., leaving £14,790 to be carried forward. The profits for 1942 included £2,000 carried over in suspense from 1941. The report states that the volume of sales has been well maintained, but gross profits have been reduced by alterations in controlled prices.

Associated Electrical Industries, Ltd., reports that after providing for taxation, the profit for the year ended December 31st last amounted to £695,266, an increase of £8,739 compared with the previous year. Depreciation requires £235,295 (£233,707), leaving a net profit of £459,971 (£452,820). A sum of £150,000 is placed to special reserve; a similar sum was placed to contingency reserve for 1942. The preference dividend absorbs £52,306 (same) and the ordinary dividend of 10 per cent., £246,092, leaving £301,309 (£289,736) to be carried forward.

S. Smith & Sons (Motor Accessories), Ltd., are to hold an extraordinary meeting on April 12th, to authorise the change of the company's name to S. Smith & Sons (England), Ltd. The change is thought desirable because of the increased scope of the company's business. It is intended that the different classes of business shall be segregated and shall be dealt with by companies with the following titles : Smiths Motor Accessories, Ltd., Smiths Aircraft Instruments, Ltd., Smiths English Clocks, Ltd., and Smiths Industrial Instruments, Ltd.

Chas. Clifford & Son, Ltd., report a balance on trading of £18,539, as compared with £18,460 for 1942. The sum of £5,000 (same) is transferred to war contingencies reserve and £2,000 (against nil) to general reserve. The final ordinary dividend is 2s. 6d. per share free of tax, again making 3s. 6d. free of tax for the year; £24,930 (against £24,791) is carried forward.

G. D. Peters & Co., Ltd., report that after allowing for depreciation, fees and E.P.T., the profit for 1943 was £63,575, as against £54,832 in the preceding year. Income tax takes £35,000 (£33,000) and staff reserve £5,000 (same). A final dividend of 7½ per cent. makes 15 per cent. (same) for the year, with a bonus of 2½ per cent. (nil), and £33,019 (£22,733) is carried forward.

International Combustion, Ltd., held its ordinary general meeting on March 22nd. Mr. G. R. T. Taylor, chairman, said that orders on hand were satisfactory and the plant was being employed to its full capacity. Output in the past financial year compared favourably with previous years.

The Greengate & Irwell Rubber Co., Ltd., announces that its profit for 1943 was £79,562, against £67,035 for 1942, after meeting taxation. The final ordinary dividend is 1s. 3d. per share, making 2s. 6d. per share for the year (against 2s.). A deferred dividend of 3d. per share (nil) is also declared.

The Hoffmann Manufacturing Co., Ltd., reports a net profit for 1943, after providing for taxation, of £217,930, as compared with £222,334 in the previous year. A final ordinary dividend of 10 per cent. is being paid, making 17½ per cent. (same), tax free, and £98,577 is carried forward.

The British Engine, Boiler & Electrical Insurance Co., Ltd., records a profit of £88,396 for the year ended December 31st last, as compared with £96,880 for 1942. The dividend is maintained at 34 per cent., leaving £153,281 (£143,600) to be carried forward.

Hoover, Ltd., held their annual meeting on March 25th when Mr. C. B. Colston (chairman and managing director) said that the company's change-over from peacetime to wartime production had been smooth and rapid and manufacturing costs compared favourably with those of other companies. He claimed that the company had earned a leading place in the light engineering industry. After the war the company would be faced with the enormous task of catching up with four or five years' normal replacement sales. He was confident that they would be able to change back to peacetime production as rapidly as they had turned over to wartime manufacture.

Lancashire Dynamo & Crypto, Ltd.—After meeting all charges, including E.P.T. and depreciation, the profit for 1943 was £127,255 (against £122,020). The final ordinary dividend is again 10 per cent., making 15 per cent. for the year (same), and the bonus of 7½ per cent. is repeated. The staff pension fund receives £3,000 and a special allocation of £10,000 is made to the staff superannuation fund. The balance carried forward is £190,180 (against £169,603).

Newman Industries, Ltd.—From a net profit, before taxation, of £70,978 (against £67,182) a dividend of 20 per cent. (same) is paid on the increased ordinary capital. No allocation is made to reserve; for 1942 the amount was £10,000.

The Telegraph Condenser Co., Ltd., is raising its dividend from 5 to 7½ per cent. The trading profit for 1943, before meeting income tax but accounting for E.P.T., was £74,502 (£66,490). After providing for depreciation, directors' fees, income tax and general reserve (£15,000 against nil) the balance carried forward is £38,181 (£38,639).

The British Aluminium Co., Ltd., reports a trading profit for 1943 of £1,045,112, including income from associated companies and after meeting E.P.T. (against £1,030,105 for 1942). The allocations include £125,000 (against £150,000) to reserve. The final ordinary dividend is again 7 per cent., maintaining the distribution at 10 per cent.

The Cambridge Instrument Co., Ltd., earned a profit of £49,049 for 1943. The ordinary dividend is 15 per cent., plus a bonus of 6d. per share, both free of tax.

The Salisbury Electric Light & Supply Co., Ltd., has declared a final dividend of 6 per cent., again making 10 per cent., for the year.

The Nigerian Electric Supply Corporation, Ltd., is maintaining its interim dividend at 3 per cent.

A. C. Cossor, Ltd., are again to pay an interim dividend of 3 per cent., tax free.

New Companies

Merseyside Electrical Engineering Co., Ltd.—Private company. Registered March 22nd. Capital, £1,000. Objects: To acquire the business of an electrical and radio engineer and building contractor carried on by Frank Taylor at 4, Mercer Court, Liverpool. Directors: W. Winstanley, Elettra, Eclan Grove, Thomas Lane, Broadgreen, Liverpool; and L. W. J. Lambert, Lowwood Cottage, Sycamore Avenue, Gt. Crosby, Liverpool. Registered office: 81, Dale Street, Liverpool.

Rothermel Corporation, Ltd.—Private company. Registered March 16th. Capital, £50,000. Objects: To acquire the business of R. X. C., Ltd., and to carry on the business of manufacturers of, and dealers in, wireless sets, batteries, accumulators, microphones, loud speakers, cathode-ray tubes, oscillograph apparatus, telegraph, telephone, electrical and optical instruments, neon and other signs, cinematograph machines, etc. Subscribers: A. J. Woods, 56, Colepits Wood Road, S.E.9, and F. J. Staines, '48, Queens Grove Road, E.4. Solicitors: Stephenson, Harwood & Tatham, E.C.

Companies' Returns

Statements of Capital

British Electric Resistance Co., Ltd.—Capital, £50,000 in 2s. shares. Return dated December 14th. All shares taken up. £10,100 paid on 101,000 shares. £39,900 considered as paid on 399,000 shares. Mortgages and charges: Nil.

Wilson & Ridley, Ltd.—Capital, £1,000 in £1 shares. Return dated January 6th. 541 shares taken up. £26 paid. £515 considered as paid. Mortgages and charges: Nil.

Wright Electric Motors (Halifax), Ltd.—Capital, £6,000 in £1 shares. Return dated March 16th, 1943 (filed February 7th, 1944). 4,146 shares taken up. £4,146 paid. Mortgages and charges: £1,000.

Masbrough Electric Supply Co., Ltd.—Capital, £5,000 in £1 shares. Return dated December 9th. 3,275 shares taken up. £3,275 paid. Mortgages and charges: Nil.

Increases of Capital

London Electrical Co. (Blackfriars), Ltd.—The nominal capital has been increased by the addition of £7,500 in £1 ordinary shares beyond the registered capital of £20,000.

Gyrotone, Ltd.—The nominal capital has been increased by the addition of £400 in £1 shares beyond the registered capital of £100.

Mortgages and Charges

Tuscan Engineering Co., Ltd.—Debenture, charged on the company's undertaking and property, present and future, including uncalled capital, dated February 24th, to secure all moneys due or to become due from the company to Barclays Bank, Ltd.

Bankruptcies

S. W. Godfrey, electrical and radio engineer, carrying on business at 141, Mansfield Road and 289, Alfred Street Central, Nottingham.—Proofs for dividend by April 8th to the trustee, Mr. A. J. Rogers, 22, Regent Street, Park Row, Nottingham.

L. R. Williams, carrying on business at 1a, Angel Street, Bridgend, as an electrical contractor.—R. Betts, of Government Buildings, 10, St. Mary's Square, Swansea, ceased to act as receiver on September 18th, 1942.

A. F. Peacock, radio engineer, 15, Bank Street, Teignmouth, Devon.—Supplemental dividend of 5s. in the £ payable on March 31st, 1944, at the Official Receiver's office, 26, Baldwin Street, Bristol, 1.

STOCKS AND SHARES

TUESDAY EVENING.

NOW that the long-anticipated "Salute the Soldier" week has been duly launched, and will be finishing in London when this issue appears, its practical effect turns out to be much the same as had been anticipated. Throughout the month of March, Stock Exchange business, investment and speculative alike, has been restrained by the probability that huge sums of money will be diverted to national loans, and, in the circumstances, surprise has been expressed that prices should have been so well maintained. A fair amount of investment takes place for employment of money upon which holders contend they must get a higher rate of interest than is afforded by National War Bonds, in order to raise the average yield earned by their capital.

Electricity Supply

Annual meetings of the electricity supply companies are producing speeches of more than usual interest from the chairmen. They deal with problems which can be summed up in the phrase Private Enterprise *v.* Bureaucracy. It goes without saying that the former is strenuously upheld by nearly all of those concerned with the direction of utility companies, of which those in the electricity supply group form an important part. From the purely Stock Exchange point of view, the opinion reflected here on previous occasions may be repeated to the effect that the companies are not likely to be affected for many years by Socialist tendencies. Therefore, share prices exhibit an attitude of indifference to the clamant calls of those who would make all industry subservient to State control. No changes have occurred in the Home list. Amongst the overseas companies' shares, Victoria Falls ordinary are $\frac{1}{8}$ down at 4¼ on demands of South African labour for increased wages. Calcutta Electric Supply ordinary are 6d. harder at 37s.

Cable & Wireless

Cable & Wireless ordinary stock has been a good market, changing hands around 82 and in fairly substantial amounts. This compares with 77½ at the beginning of the year. Purchases in advance of the forthcoming dividend are responsible for the improvement. For each of the past six years, the ordinary dividend has been 4 per cent., paid once a year, and it is assumed that the same rate will be maintained in respect of the year recently ended. The present price may be said to include in it the full twelve-month dividend, say a little under 40s. per cent. net., giving a return on the money of practically 5 per cent. The Combine's dividend receives a certain amount of Dominion relief in respect of income tax, and, if last year's experience is repeated, this relief will have the effect of raising the yield to a little over 5¼ per cent. on the money. Compared with the return offered by ordinary stocks of somewhat similar class, this is not bad. The dividend announcement is generally made in May.

Price Fluctuations

London Passenger Transport "C" stock is maintaining its advanced figure of 70, but the Board's senior stocks have gone back. The 5 per cent. "B" is 2 points lower at 119½. Southern Railway 5 per cent. preference is 1½ down at 115; the 5 per cent. preferred ordinary is unchanged at 76½. In the foreign list, Brazilian Tractions came into sudden prominence with a rise of 1¼ to 27¾. Talk of a probable increase in the dividend is the nominal reason for the buying that caused the spurt.

The ordinary shares in the equipment and manufacturing group are what the Stock Exchange calls "steady to good." Midland Electric Manufacturing at £7 are 7s. 6d. higher. British Insulated are up to 107s. Ericsson Telephones at 52s. 9d. have recovered the amount of the dividend. De la Rue, after being 8, rose to 8¼. Telegraph Condensers are $\frac{3}{16}$ up at 22s. 6d. upon the raising of the dividend from 5 to 7½ per cent. A rise of 1s. lifted Walsall Conduits to 47s. 6d. Electric Constructions at 52s. have gained a florin. Switchgear & Cowans rose to 18s. 6d. Hall Telephones are a trifle better. A fall of 1s 6d. in Telegraph Constructions, to 50s. 6d., is an exception to the general tendency of the market. Vactrics are 3d. down at 14s. 9d.; the company's year ends with this month.

Associated Electrical

Associated Electrical Industries made a profit for the year ended December 31st, 1943, of £695,000 being £8,700 better than the profit for 1942; the net is £7,151 up. The company was registered forty-five years ago as British Westinghouse Electric & Manufacturing Co. Twenty years later, the name was changed to Metropolitan-Vickers Electrical Co., Ltd., and the present title was substituted in 1929. A dividend of 10 per cent. has been paid annually since 1936. For 1933 the dividend was 3 per cent. on the ordinary shares. The present price is 51s. 6d. The last issue made in right to the ordinary shareholders was at a guinea in December, 1931.

Enfield Cable Works

This company is paying a final dividend of 6¼ per cent., making, as usual, 12½ per cent. for the year, the rate paid in each of the past

(*Continued on page* 467)

ELECTRICAL INVESTMENTS

Prices, Dividends and Yields

Company	Dividend Previous	Dividend Last	Middle Price Mar. 28	Rise or Fall	Yield p.c. £ s. d.
Home Electricity Companies					
Bournemouth and Poole	12½	12½	62/–	..	4 °0 8
British Power and Light	6	7	33/–	..	4 4 10
City of London ..	7	5½	27/6	..	4 0 0
Clyde Valley ..	8	8	41/6	..	3 17 0
County of London	8	8	40/–	..	4 0 0
Edmundsons:					
7% Pref. ..	7	7	34/6	..	4 1 4
Ord.	6	6	29/–	..	4 2 9
Elec.Dis.Yorkshire	9	9	44/6	..	4 1 0
Elec. Fin. and Securities ..	12½	12½	55/–	..	4 11 0
Elec. Supply Corporation ..	10	10	47/–	..	4 5 0
Isle of Thanet ..	Nil	Nil	18/–	..	—
Lancs. Light and Power ..	7½	7½	36/–	..	4 3 4
Llanelly Elec. ..	6	6	25/–	..	4 16 0
Lond.Assoc.Electric	3	4	23/–xd	..	3 9 7
London Electric	6	6	28/–	..	4 5 9
LondonPowerRed. Deb.	5	5	103½	..	4 14 7
Metropolitan E.S.	8	8	40/6	..	3 19 0
Midland Counties	8	8	40/6	..	3 19 0
Mid. Elec. Power	9	9	45/–	..	4 0 0
Newcastle Elec.	7	7	30/6	..	4 12 0
North Eastern Elec.:					
Ordinary ..	7	7	33/6	..	4 3 7
7% Pref. ..	7	7	35/–	..	4 0 0
Northampton ..	10	10	48/–	..	4 3 4
Notting Hill 6% Pref. (£10) ..	6	Nil	11	..	—
Northmet Power:					
Ordinary ..	7	7	38/–	..	3 13 9
6% Pref. ..	6	6	30/6	..	3 18 8
Richmond Elec. .	6	6	25/6	..	4 14 1
Scottish Power ..	8	8	40/6	..	3 19 0
Southern Areas .	5	5	23/–	..	4 7 0
South London ..	7	7	28/–	..	5 0 0
West Devon ..	5	5	23/6	..	4 5 0
West Glos. ..	4½	3½	23/6xd	..	2 19 7
Yorkshire Elec. .	8	8	43/–	..	3 14 5
Overseas Electricity Companies					
Atlas Elec. ..	Nil	Nil	6/3	..	—
Calcutta Elec. ..	7*	6*	37/–	+6d.	3 4 10
Cawnpore Elec...	10	10	35/–	..	5 14 3
East African Power	7	7	33/–	..	4 4 10
Jerusalem Elec...	7	5	28/6	..	3 10 2
Kalgoorlie (10/–)	5	5	10/–	..	5 0 0
Madras Elec. ..	4*	Nil	23/–	..	—
Montreal Power..	1½	1½	22½	–1	6 13 4
Palestine Elec."A"	4*	5*	40/–	..	2 10 0
Perak Hydro-elec.	6	7	10/–	..	—
Shawinigan Power	83cts.	90cts.	17	..	—
Tokyo Elec. 6%	6	6	18	..	—
Victoria FallsPower	15	15	4½	–½	3 10 7
Whitehall Inv.Pref.	—	6	23/6xd	+6d.	5 2 2

Company	Dividend Previous	Dividend Last	Middle Price Mar. 28	Rise or Fall	Yield p.c. £ s. d.
Public Boards					
Central Electricity:					
1955-60 (Civil Defence) ..	—	2	100	..	3 0 0
1955-75 ..	5	5	114	..	4 7 9
1951-73 ..	4½	4½	107	..	4 4 1
1963-93 ..	3½	3½	104	..	3 7 4
1974-94 ..	3½	3½	101	..	3 4 6
London Elec. Trans. Ltd.	2½	2½	97	..	2 11 3
London & Home Counties1955-75	4½	4½	113	+1	3 19 8
Lond.Pass.Trans.:					
A	4½	4½	122½	–1	3 13 6
B	5	5	119½	–2	4 3 8
C	3	3½	70	..	4 12 10
WestMidlandsJ.E.A. 1948-68 ..	5	5	108½	..	4 12 4
Telegraph and Telephone					
Anglo-Am. Tel.:					
Pref.	6	6	117½xd	..	5 2 2
Def.	1½	1½	29	..	5 3 5
Anglo-Portuguese	8	8	24/–	..	6 13 4
Cable & Wireless:					
5½ Pref. ..	5½	5½	115½	–½	4 15 3
Ord.	4	4	81½	..	4 18 2
CanadianMarconi$1	Nil	4cts.	9/9	..	—
Globe Tel. & Tel.:					
Ord.	8½*	5*	37/6	..	2 13 4
Pref.	6	6	30/–	..	4 0 0
Great Northern Tel. (£10)	Nil	Nil	21½	+2	—
Inter. Tel. & Tel.	Nil	Nil	16½	..	—
Marconi-Marine..	7½	7½	33/–	..	4 11 0
Oriental Tel. Ord.	16	10	44/–	..	—
Telephone Props.	6	Nil	16/–	..	—
Tele.Rentals(5/–)	10	10	11/6	..	4 7 0
Traction and Transport					
Anglo-Arg.Trans.:					
First Pref. (£5)	Nil	Nil	2/6	..	—
4% Inc. ..	Nil	Nil	7	..	—
Brit.Elec.Traction:					
Def. Ord. ..	45	45	1115	..	4 0 7
Pref. Ord. ..	8	8	175	..	4 11 5
Bristol Trams ..	10	10	54/6	..	3 13 5
Brazil Traction ..	$1	$1½	27½	+1½	6 12 6
Calcutta Trams	5½	6½	39/–	..	3 6 8
Cape Elec. Trams	5	6	26/–	..	4 12 4
Lancs. Transport	10	10	45/6	..	4 8 0
Mexican Light:					
1st Bonds ..	5	5	101½	..	4 18 7
Rio 5% Bonds ..	5	5	106½	..	4 13 9
Southern Rly.:					
5% Prefd. ..	5	5	76½	..	6 10 9
5% Pref. ..	5	5	115	–1½	4 7 0
T. Tilling ..	10	10	58/–	..	3 9 0
West Riding ..	10	10	45/–	..	4 9 0

(*Continued on next page*)

* Dividends are paid free of Income Tax.

Company	Dividend Previous	Dividend Last	Middle Price Mar. 28	Rise or Fall	Yield p.c.
Equipment and Manufacturing					£ s. d.
Aron. Elec. Ord. ..	10	15	55/–	..	5 9 1
Assoc. Elec.:					
Ord.	10	10	51/3xd	..	3 17 8
Pref.	8	8	39/6	..	4 1 0
Automatic Tel. & Tel.	12½	12½	61/–	..	4 0 8
Babcock & Wilcox	11	11	50/–	..	4 8 0
British Aluminium	10	10	47/-xd	..	4 5 1
British Insul. Ord.	20	20	5½½	+½	3 14 4
British Thermostat (5/–)	18½	18½	19/–	..	4 17 4
British Vac. Cleaner (5/–)	15	30	28/–	+1/–	5 7 1
Brush Ord. (5/–)	6	8	9/–	..	4 9 0
Burco (5/–) ..	15	17½	15/6	..	5 13 0
Callender's ..	15	20	163/–	..	3 17 8
Chloride Elec. Storage	15	15	80/–	..	3 15 0
Cole, E. K. (5/–)	10	15	26/3	..	2 17 2
Consolidated Signal	24	27½	6	..	4 11 6
Cossor, A. C. (5/–)	7½*	10*	23/6	–1/–	2 2 6
Crabtree (10/–) ..	17½	17½	38/3xd	..	4 11 5
Crompton Parkinson Ord. (5/–) ..	20	22½	29/–	..	3 17 7
E.M.I. (10/–) ..	6	8	29/6	+6d.	2 4 2
Elec. Construction	10	12½	52/–	+2/–	4 16 2
Enfield Cable Ord.	12½	12½	59/6	+6d.	4 4 0
English Electric .	10	10	50/–	..	4 0 0
Ensign Lamps (5/–)	25	15	22/6	..	3 6 8
Ericsson Tel. (5/–)	22*	20*	52/9xd	+9d.	1 18 0
Ever Ready (5/–)	40	40	39/–	..	5 2 7
Falk Stadelmann	7½	7½	33/6	..	4 9 7
Ferranti Pref. ..	7	7	30/–	..	4 13 4
G.E.C.:					
Pref.	6½	6½	34/–	..	3 16 6
Ord.	17½	17½	92/–	..	3 16 1
General Cable (5/–)	15	15	15/–	..	5 0 0
Greenwood & Batley	15	15	41/3	..	7 5 9
Hall Telephone (10/-)	12½	12½	26/6	+3d.	4 14 4
Henley's (5/–) ..	20	20	26/3	..	3 16 2
4½% Pref. ..	4½	4½	24/–	..	3 15 0
Hopkinsons ..	15	17½	62/6	..	5 12 0
India Rubber Pref.	5½	5½	22/–	..	5 0 0
Intl. Combustion	30	30	6½	..	4 18 0
Johnson & Phillips	15	15	72/–	..	4 3 4
Lancashire Dynamo	22½	22½	92/-xd	..	4 17 10
Laurence, Scott (5/–)	12½	12½	13/–	..	4 16 2
London Elec. Wire	7½	7½	34/–	–6d.	4 8 3
Mather & Platt .	10	10	54/6	..	3 14 5
Metal Industries (B)	5	8	47/6	+1/6	3 7 6
Met. Elec. Cable Pref.	5½	5½	21/3	..	5 3 6
Murex	20	20	103/3	+9d.	3 17 6
Pye Deferred (5/–)	25	25	26/3	..	4 15 3
Revo (10/–) ..	17½	17½	38/6	..	4 11 0
Reyrolle ..	12½	12½	68/9	..	3 12 8
Siemens Ord. ..	7½	7½	33/–	–6d.	4 11 0
Strand Elec. (5/–)	7½	10	7/9	..	6 9 0
Switchgear & Cowans (5/–) ..	10	20	18/6xd	+1/–	5 8 1
T.C.C. (10/–) ..	5	7½	22/6	+½	3 6 8
T.C. & M. ..	10	10	50/6	–1/6	3 19 3
Telephone Mfg. (5/–)	9	9	11/–	..	4 1 10
Thorn Elec. (5/–)	20	20	22/6	..	4 9 0
Tube Investments	20	20	96/6	..	4 3 0
Vactric (5/–) ..	Nil	Nil	14/9	–3d.	—
Veritys (5/–) ..	7½	7½	7/6	..	5 0 0
Walsall Conduits (4/–)	55	55	47/6	+1/–	4 13 7
Ward & Goldstone (5/–)	20	20	26/6	..	3 15 6
Westinghouse Brake	12½	14	71/3	..	3 18 6
West, Allen (5/–)	7½	7½	7/3	..	5 3 5

* Dividends are paid free of Income Tax.

Stocks and Shares (*Continued from page* 465)

three years. Previously, in 1938 and 1939, the dividend was 16½ per cent. annually, following upon 15 per cent. in each of the five preceding years. In 1936, the capital was raised from £400,000 to half a million pounds, and in 1938 another increase, this time to £800,000, the present capital, was accomplished. The company's results for the year ended 1943 showed a reduction in the net profit of £49,000; taxation eats largely into earnings. The balance sheet is strong, showing a good financial position, and the price of the shares is 6d. better at 59s. 6d., at which the return on the money is 4 guineas per cent. To-day's price is about the highest touched in seven years; within that time it has been down to £2.

India Rubber Preference

India Rubber, Gutta Percha & Telegraph Works reports a profit, for the year to September 30th last, of £169,000, being £24,800 up on the year. The net profit of £58,920 was £16,000 better and the dividend on the ordinary shares is again 9 per cent. The company's 6 per cent. preferred shares are entitled to an extra 2 per cent., which they receive once more. The company is controlled by British Tyre & Rubber, and, in its turn, owns practically the entire capital of Jointless Rims, Ltd. and Palmer Tyre, Ltd. The chairman said in his statement last year that the outlook, although admittedly obscure, was reasonably encouraging, and this is borne out by the figures just quoted. The preference shares stand at 22s. 6d., and, as those who follow the course of the price from the figures in our table will have observed, it is seldom that variations occur in the quotation.

Radio Shares

Electric & Musical shares have been a moderately active market. The price is up to 29s. 6d. No fresh reason has appeared to account for the persistence of the support. Philco, after fluctuating between 13s. and 12s., rallied from the lower price to 12s. 9d. Pye deferred show no change at 26s. 3d. Cossor shares at 23s. 6d. are 6d. lower; the company is to repeat its interim dividend of 3 per cent., tax free. For the whole of last year, the dividend was made up to 10 per cent., tax free.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (1s. *each*) *may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2.*

AKT.-GES. Brown, Boverie & Cie.—"Gas turbine plant with multi-stage air compression." 2903/43. February 20th, 1942. (559839.)

Babcock & Wilcox, Ltd.—"Attemperating apparatus for controlling the temperature of steam or other vapour." 12702/42. October 10th, 1941. (559956.)

British Thermostat Co., Ltd., and W. F. F. Martin-Hurst.—"Flexible metallic bellows." 5673. May 1st, 1941. (559844.)

British Thomson-Houston Co., Ltd.—"Starting switches for electric-discharge devices." 13147/42. September 19th, 1941. (559898.)

British Thomson-Houston Co., Ltd., and J. H. Walker.—"Inductor couplings and eddy-current brakes." 7635. June 4th, 1942. (559912.)

British Thomson-Houston Co., Ltd., E. J. G. Beeson and J. G. Brett.—"Electric-discharge devices." 15093. October 27th, 1942. (559824.)

R. Burton, Ltd., and H. Burton.—"Means for conserving and utilising the heat radiated from steam generator and boiler fronts." 16123. November 14th, 1942. (559906.)

E. K. Cole, Ltd., A. W. Martin, F. A. Inskip and C. J. W. Newberry.—"Electrical transformers." Cognate applications 1459/43 and 12454/43. January 28th, 1943. (559831.)

G. A. Combridge.—"Electric welding rod holder." 10494. July 27th, 1942. (559888.)

Crompton Parkinson, Ltd. and A. W. Angold.—"Means for mounting the quadrature loop on watt-hour meters and like instruments." 16882. November 27th, 1942. (559826.)

E. I. Du Pont de Nemours & Co.—"Electrically insulated conductors in which the insulation comprises a high molecular weight polymer." 9699/42. July 14th, 1941. (559858.)

W. A. Edwards.—"Suction cleaners." 17061. December 1st, 1942. (559936.)

Electrical Apparatus Co., Ltd., J. R. Walton and F. N. Woodger.—"Electro-magnetic relays." 12313. September 1st, 1942. (559868.)

C. H. Flurscheim and Metropolitan-Vickers Electrical Co., Ltd.—"Air or gas-blast electric circuit-breakers." 14782. October 21st, 1942. (559904.)

Jackson Electric Stove Co., Ltd., and E. O. Lemon.—"Electric snap-action switches." 16249. November 17th, 1942. (559908.)

Johnson & Phillips, Ltd., and G. T. W. Whitehead.—"Cable ships' equipment." 16091. November 13th, 1942. (559931.)

Landis & Gyr. Soc. Anon.—"Small electric motors, more especially synchronous motors." 8793/42. July 14th, 1941. (559946.)

Londex, Ltd., and J. V. Dossett.—"Light buoys." 10660. July 30th, 1942. (559949.)

Marconi's Wireless Telegraph Co., Ltd.—"Method of producing finely divided material." 10704/42. January 18th, 1941. (559815.)

Maschinenfabrik Oerlikon.—"Centrifugal blowers." 2981/43. February 13th, 1942. (Addition to 542468.) (559840.)

Micafil, Ltd.—"Bushing insulators." 5402/42. April 23rd, 1941. (559846.)

J. L. Musgrave.—"Heating or cooling of buildings." 12367. September 2nd, 1942. (559872.)

H. N. Negretti, P. E. Negretti and H. W. Ibbott.—"Automatic control of a variable condition." 9108. July 1st, 1942. (559813.)

Okonite-Callender Cable Co., Inc.—"Electric cables." 13802/42. September 13th, 1941. (559924.)

Oldham & Son, Ltd., H. Akroyd and H. Holt, Jnr.—"Electrical cut-outs." 13176. September 18th, 1942. (559923.)

Permutit Co., Ltd., and E. L. Holmes.—"Ion-exchange materials and their use in the treatment of liquids." Cognate applications 11619/41, 13599/41 and 14382/41. September 10th, 1941. (559941.)

Philips Lamps, Ltd. (Naamlooze Vennootschap Philips' Gloeilampenfabrieken).—"Circuit arrangements for discharge tube amplifiers." 3053. February 24th. 1943. Addition to 554371. (559841.)

Revo Electric Co., Ltd., and F. H. Reeves.—"Fluorescent tubular discharge lamp fittings." 15446. November 3rd, 1942. (559825.)

Standard Telephones & Cables, Ltd.—"Antenna systems." 8821/42. July 2nd, 1941. (559886.) "Gaseous electric-discharge device." 13848/42. October 4th, 1941. (559902.)

Stratton & Co., Ltd., and H. A. J. Laughton.—"Radio receiving and transmitting sets." 12563. September 5th, 1942. (559877.)

Ultra Electric, Ltd., and F. Hasson.—"Electro-magnetic cutouts and relays." Cognate applications 10865/42 and 14910/42. August 4th, 1942. (559863.)

United Insulator Co., Ltd., and N. G. Westcombe.—"Electrical condensers." 12657. September 8th, 1942. (559920.)

Western Electric Co., Inc.—"Electric signal transmission systems." 16178/42. December 9th, 1941. (559907.)

Westinghouse Electric International Co.—"Devices for threading a length of material between work devices such as adjacent roll stands of a strip rolling mill." 2092/43. February 21st, 1942. (559834.)

TRADE MARK APPLICATIONS

THE following applications have been made for British trade marks. Objections may be entered within a month from March 22nd:—

ACCROMETON. No. 623,698, Class 9. Electrical apparatus and instruments not included in other classes; cinematograph apparatus.—Accrometer Manufacturing Co., Ltd., 22, High Street, Kingston-on-Thames.

ARGOSTRON and NEOSTRON. Nos. 626,105 and 626,106 respectively, Class 9. Gas-filled stroboscopic electric-discharge tubes.—Ferranti, Ltd., Wickentree Lane, Hollinwood, Lancs.

NEW BOOKS

Electrical Measurements—Radio—Metallurgy

Alternating Current Bridge Methods. By B. Hague. Fifth edition. Pp. 616; figs. 207. Sir Isaac Pitman & Sons, Ltd., 39, Parker Street, London, W.C.2. Price 30s.

In view of the difficulty of keeping in touch with European technical literature no attempt has been made in this new edition to record the development of AC bridge measurement with any degree of completeness, but a few small changes have been introduced. A series of supplementary notes, to which cross-reference is made in the text, have been included on certain important topics. Further work has been done on sensitivity calculations for bridge networks and on the estimation of balance convergence. There is also a reference to the question of errors caused in bridge balances by cross-admittances between the branches.

Radio Upkeep and Repairs: A Practical Handbook on Servicing Principles and Receiver Maintenance. By Alfred T. Witts. Sixth edition. Pp. 237; figs. 166. Pitman & Sons. Price 7s. 6d.

Since this book was first published in 1933 five revisions have been carried out, with the result that very little of the original text remains. In this latest edition the chapter on "Gramophone Pick-ups; How to Fit, Use and Service," is entirely new, the older chapter on pick-ups having been deleted. Many additions and alterations have also been made to the chapter on "Servicing Mains Supply Equipment," in order to bring it into line with modern practice. The general plan of the book remains the same, however, concentrating on practical information and omitting theory.

Engineering Materials. By A. W. Judge. Vol. I: "The Ferrous Metals." Pp. 369; figs. 158. Price 25s. Vol. II: "The Non-Ferrous Metals and Organic Materials." Pp. 496; figs. 201. Price 30s. Pitman & Sons.

The progress of the science of metallurgy has led in recent years to an almost phenomenal expansion in the number of metals and alloys which are available to the engineer. Not so very long ago his choice was limited to cast-iron, wrought iron and steel among the ferrous metals. To-day, not only are there various grades of cast-iron, but the use of the rarer metals, such as tungsten and vanadium, has led to the production of large numbers of alloy steels, each possessing specific characteristics which render it far superior to anything which was available to the engineer of a previous generation. Furthermore, the commercial production of metals such as aluminium and magnesium has placed in our hands an entirely new range of non-ferrous alloys. It follows that the engineer and the designer must have a working knowledge of all these metals and of their special properties, if he is to keep abreast of modern practice in any particular branch of the engineering industry. The books under review have been written to provide this knowledge.

Originally published in 1920, they have been largely re-written, as was only to be expected in view of the enormous developments which have occurred since that date. In the first volume the author deals exclusively with the ferrous metals, covering the various grades of cast-iron, the carbon steels and the alloy steels. In each case the composition and the method of production are given, together with the mechanical and physical properties. The question of heat treatment is dealt with, while such problems as machining and welding are also considered. Reference is also made to the commercial applications of the various irons and steels. Of particular interest to the electrical engineer is the chapter devoted to the irons and steels which are now being so widely used in electrical practice, including the various magnetic and non-magnetic metals and the alloys employed on account of their high electrical resistivity. The various types of electric furnaces used in the manufacture of iron and steel are also described.

Mr. Judge is an authority on motor cars and aircraft and, as might be expected, the second volume on non-ferrous metals and organic materials deals very largely with the application of such materials used in their construction. He does not, however, entirely neglect the electrical and heavier industries, and whilst readily agreeing that the non-ferrous materials lend themselves to the lighter branches of engineering, we could wish that more pages had been allotted to their many applications in the sphere of electrical engineering.

The books should undoubtedly prove of very great value in the library of every engineering design office.—L.J.P.

Plastics in the Radio Industry. By E. G. Couzens and W. G. Wearmouth. Pp. 57; figs. 21. Hulton Press, Ltd., 43, Shoe Lane, London, E.C.4. Price 2s. 8d. post free.

This latest addition to the series of "Electronic Engineering" monographs begins with an explanation of the nature of plastic substances, differentiating between many types. The next three chapters are concerned with the preparation of derivatives and formation of compounds as well as the manufacture from them of radio components, the physical properties of numerous substances being set out. The fifth chapter deals with methods of manipulation for fabrication and the sixth section with electrical properties. Cements and solvents are given in the first appendix and identification tests in the second, while the third contains three pages of books of reference and published articles on the subject.

Shorter Notices

Electric Wiring.—By W. Clinton, M.I.E.E., and E. H. Freeman, M.I.E.E. Ninth edition. Pp. 276; figs. 98. John Murray, Albemarle Street, London, W. Price 5s.

Thermodynamics Applied to Heat Engines. By E. H. Lewitt. Third edition. Pp. 494; figs. 185. Pitman & Sons. Price 25s.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

Contracts Open

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Belfast.—April 12th. City Council. Three electrically driven propeller extraction fans complete with motors, wiring and all necessary fittings. Particulars from the City Surveyor's Office, Room 88, City Hall.

Dundee.—April 5th. Corporation Emergency Committee. Electric lighting and heating installation in control room. Particulars from city quantity surveyor, 21, City Square.

North-West Midlands.—May 10th. Joint Electricity Authority. Piping equipment and overhead electric cranes. (March 3rd.)

West Midlands.—April 28th. Joint Electricity Authority. Automatic fire-fighting equipment. (See this issue.)

Orders Placed

Dundee.—Corporation Housing Committee. Accepted. Electric lighting installation for Broughty Ferry housing scheme of 18 houses (£254).—J. R. Installation Co.

Mansfield.—Electricity Committee. Accepted. Two 300-kVA transformers.—Brush Electrical Engineering Co.

Urmston.—Public Works Committee. Accepted. Electrically operated baling press for Salvage Department (£220).—F. Tonge & Son.

Contracts in Prospect

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Altrincham.—Alterations to Hippodrome (electrical work); Hargreaves, Ltd., Hippodrome.

Houses and shops, Bridge Hall estate; Smith & Allcock, Ltd., builders, 471, Chester Road, Manchester, 16.

Amble.—Rebuilding a cinema; R. Carse & Sons, High Street, Amble, Northumberland.

Audenshaw.—Extensions to Grammar School; secretary, board of governors.

Bolton.—Workshop additions and alterations, Back Plover Street; R. J. Tyson, Ltd., building contractors, Wellington Mills.

Brighton.—Remand home (£6,500); borough engineer.

Church Stretton.—Meals kitchen and dining hall; surveyor, Council Offices, Church Stretton, Salop.

Coatbridge (Lanarkshire).—Extension of municipal building; burgh surveyor.

Consett.—Completion of 30 houses for the U.D.C.; architect, Council Offices, Derwent Street, Blackhill.

Coventry.—Two prefabricated buildings for Infants' Department, Moseley Avenue Council School; D. E. E. Gibson, city architect, 1a, Warwick Row.

Dewsbury.—Machine shop, Scarborough Sawmills; W. Hodgson & Sons, Ltd., Savile Town.

Additions to Dyeworks, Ravensthorpe, for James Smith & Sons (Cleaners), Ltd.

Durham.—Remand home for girls, Darlington; W. F. Merrett, county engineer, Shire Hall, Durham City.

Eldwick (Yorks).—Institute and club; J. R. Bruce, Eldwick, nr. Bingley.

Felling-on-Tyne.—School kitchen and dining hall in Falla Park Road and canteen at Bill Quay; U.D.C. architect.

Hertfordshire.—Extensions, Children's Home, Hemel Hempstead; county architect, Hertford.

Hyde.—Works additions; E. Peart & Co., Ltd., Onward Works, Gordon Street

Works extensions, Bayley Field Mill, Newton; Ashton Bros. & Co., cotton spinners, Carrfield Mills.

Jarrow.—Conversion of clinic into an R.C. school; R. Burke, Singleton House, Newcastle-on-Tyne.

Lancashire.—Meals kitchen, Ulverston; A. T. Nicholson, county architect, County Buildings, Fishergate Hill, Preston.

Lichfield.—Public hall; L. Straw, city engineer, Guildhall.

London.—ST. MARYLEBONE.—Offices, 176-204, Marylebone Road; J. Stanley Beard & Bennett.

Macclesfield.—Factory; Halles, Ltd., ladies' gown manufacturers, Chester Road Mills.

Manchester.—Canteen kitchen at Staincliffe Road, Sharston; J. B. Brez, chief surveyor, Education Offices, Deansgate, Manchester, 3.

Mansfield.—Works additions; Westfield transport Co., Westfield Lane.

Additions to out-patients' department, West Hill Drive, for Mansfield & District General Hospital; secretary, board of governors.

Works additions, Southwell Road; G. Mawer & Sons.

Workshop, Moor Lane; Hodgkins & Co.

Meltham.—Housing scheme for U.D.C.; P. N. Brown, architect, Hollowgate, Holmfirth nr. Huddersfield.

Northampton.—Houses for Federation of Women's Institutes; P. M. Powell, architect, 15, Norfolk Street, Sanderstead, Surrey.

Paisley.—Houses (130) for Corporation; burgh surveyor.

Perth.—Extensions, maternity department of Royal Infirmary (£5,000); medical superintendent.

Rawtenstall.—Canteen, Albert Works, Whitewell Bottom; Mitchells, Ashworth, Stansfield & Co., Ltd.

Stirling.—Picture house for Stirling Cinema & Variety Theatres, Ltd., Raploch; secretary.

Trimdon.—Miners' canteen; G. Henderson, Boldon Lane, East Boldon, Co. Durham.